The Royal Aeronautical Society

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PROCEEDINGS

Eighteenth Wilbur Wright Memorial Lecture

The Eighteenth Wilbur Wright Memorial Lecture was delivered to the Royal Aeronautical Society, in the Lecture Theatre of the Royal Society of Arts, on Friday, May 30th, 1930, by Mr. H. R. Ricardo, F.R.S., F.R.Ae.S., M.I.A.E., Assoc.M.Inst.C.E., on "The Development and Progress of the Aero Engine."

The President of the Society (Colonel the Master of Sempill) was in the chair.

The PRESIDENT: It would be agreed that there was no lecture delivered before any aeronautical society in the world which was more revered than the Wilbur Wright Memorial Lecture. This lecture was founded as a memorial to Wilbur Wright, the first man to achieve controlled power-driven flight in a heavier-than-air machine. That flight was made in 1903.

In the name of the Society a cable had been sent to Mr. Orville Wright, in the following terms:—

> "Once again we are privileged to pay homage to the memory of your distinguished brother, and we also wish to express great pleasure in the knowledge that you are still playing a prominent part in the development of aeronautics. The memorial lecture this year deals with aircraft engine development—a peculiarly appropriate subject, since the name of Wright will be handed down to posterity as that of the first person in the world to pilot a power-driven aeroplane."

The privilege of giving the Wilbur Wright Memorial Lecture was greatly sought after and was a much prized honour which could only fall to the lot of a few. He believed that the Council, in selecting the title for this Eighteenth Lecture, had acted wisely, and that they could not have selected a man better qualified than Mr. Ricardo to undertake its delivery.

This occasion was a peculiarly appropriate one, because only a few days ago the Aeronautical Research Committee (as it is now called) had come of age. The Society was particularly glad to welcome Sir Richard Glazebrook, who had been largely responsible for the foundation of that Committee and had served as its Chairman during the 21 years of its life. Its first meeting was held on May 12th, 1909, and it had done very useful work during its lifetime; it was the model of what an aeronautical research committee should be. It was far and away the first of any such committees to be set up by any Government to deal with aeronautics. At the dinner of the Council of the Royal Aeronautical Society, which was to be held after the delivery of the Wilbur Wright Lecture, it would be his privilege, on behalf of the Society, to ask Sir Richard to accept a small gift as a memento of the 21st anniversary of the foundation of the Aeronautical Research Committee.

The President also drew attention to the fact that the Society's Vice-President, Colonel Moore-Brabazon, was also celebrating a 21st anniversary—that

of the first power-driven flight ever made in this country. That flight was made on May 2nd, 1909, by Lieut.-Colonel Moore-Brabazon.

The President did not propose to review in any detail the development of the aero engine since the Wright Brothers had designed and constructed their first engine some 26 or 27 years ago, because that would be done by Mr. Ricardo, but he would like to recall one or two facts. After the Wright Brothers had made experiments with various wing sections, which led to their constructing a glider, which had flown successfully, they appreciated that all that was required in order to achieve mechanical flight was the acquisition of an engine. They had hoped to have been able to obtain a suitable engine in America, but had found that that was not possible, and after designing the airscrew, which had given an efficiency of approximately 66 per cent., they had designed and constructed an engine, with which they had made the first flights ever made by man in a power-driven machine. That engine and machine were in the Science Museum at South Kensington, and he hoped they would remain there for a long time.

The introduction of Mr. Ricardo to an audience such as that which he was about to address was unnecessary, because his name was so well known. He made his first attempt at design and construction about 1900, when he was at Rugby. At that time he constructed a steam-driven motor cycle, the fuel—coal—being carried in specially constructed and capacious pockets in the jacket he used to wear when wrestling with that monster. Subsequently he worked with the late Professor Hopkinson, who would be remembered as the Controller of Experiments in the early stages of the war. During the war Mr. Ricardo had carried out important advisory work in connection with the development of aero engines and tank engines. Since the war he had built up an international reputation as a pioneer in research on internal combustion engines and in particular the exploration of the phenomenon of detonation. That work was known throughout the world, and reflected tremendous credit upon Mr. Ricardo and those associated with him. He had published a standard work on the internal combustion engine, in two volumes, besides contributing many papers to scientific and engineering societies; the Royal Aeronautical Society had been privileged to listen to a lecture by him on a previous occasion. In 1928 he had been made a Fellow of the Royal Society, in recognition of his work. He was appealed to by practically everyone responsible for the design and development of engines in this country and by many on the Continent and in the United States of America. His pioneer work related not only to the development of the internal combustion engine, but also to the development of the compression ignition engine.

Presentation of the Society's Silver Medal

The President then extended a hearty welcome to one whom the Society had never had the privilege of welcoming before, and whose name was so well known in the engineering world, probably before Mr. Ricardo was born—certainly when he was in his cradle. This gentleman was Mr. F. H. Royce, who had been awarded the Society's Silver Medal in 1929 for his brilliant work in connection with the development of aircraft engines and, in particular, in the development of the engine which, when fitted to the Supermarine S.6, had enabled Great Britain to achieve such a conspicuous victory in the Schneider Trophy Contest of 1929. But for the unfortunate fact that Mr. Royce had been ill, and had been away in order to recuperate, he would have had the privilege of presenting the medal to him on an earlier occasion.

It was difficult, if not impossible, for one to say anything about Mr. Royce that was not already well known. The name of Royce, coupled with that of

Rolls, had really become a part of the English language—indicative of the superlative in design and construction. Mr. Royce had served his apprenticeship many years ago in the Great Northern Railway shops at Peterborough. About 50 years ago, with Mr. Claremont, he founded the firm of Royce, Ltd., in Manchester, to make arc lamps and electrical equipment, cranes and the like. Shortly after 1900 he had turned his attention to the development of the motor car and had designed and constructed a number of those famous two-cylinder 10 h.p. cars, at least one of which was still running. About that time he had been joined by the late Mr. C. S. Rolls, and so there was brought about the combination of those two very famous names. Mr. Claremont had used one of the cars for business purposes, but apparently he had had far less confidence in the engineering skill and ability of Mr. Royce than we have to-day, because whenever he had allowed himself to be driven about in his car he had always arranged that his private hansom should follow, in case the car should break down. Indeed, so certain had he been of breakdowns that he had had that classic notice fitted to his car: "If the car breaks down, please do not ask a lot of silly questions."

Long before the war Mr. Royce was anxious to design an aircraft engine, but such was the success being achieved in the automobile world by his productions that his co-directors—who had not the foresight of Mr. Royce—would not allow him to devote his attention to aviation. The war, however, had altered the situation, and, encouraged and assisted by the Technical Department of the R.N.A.S., Mr. Royce had produced the first of a long and successful line of aircraft engines of widely different types. The successes in the war and in the time of peace, in airships and in aeroplanes, with Rolls-Royce engines, was a matter of history. Among the conspicuous achievements with these engines there was the first direct crossing of the Atlantic by an aeroplane, and the first direct flight from England to Australia. Then had come the remarkable development of the engine which had performed so successfully in the Schneider Trophy Contest—designed, developed and tested in record time, and running without a falter throughout the race—quite the most remarkable engine of our day, and an engine that had brought credit not only to his name and to his firm, but also to the British aircraft industry, which had been responsible for the production of many fine engines. Even if we had the doubts that seemed to have assailed Mr. Royce's co-directors in the early days, we could not find anything that could fulfil the duties of that hansom cab and be fast enough to follow a Supermarine S.6 with a Rolls-Royce engine.

One supposed that the secret of Mr. Royce's astounding success was his indefatigable energy and industry, as well as, of course, his profound knowledge of all the principles of engineering. He lived for one thing alone, and that was his work, and he had set a standard in this that we should all aim at, but could not hope to surpass.

Perhaps one of the most interested spectators of the tribute which the Society was paying to Mr. Royce on the occasion of this meeting would be Herr Kronfeld, the foremost exponent of soaring flight, who had flown on two occasions last year for 100 miles without an engine and hoped at east to equal, if not to surpass, this achievement in this country. The Society extended a hearty welcome to Herr Kronfeld.

In presenting the Society's Silver Medal to Mr. Royce, the President said he considered it a great privilege to be able to do so. It was a privilege that he should happen to be President of the Society on this occasion, and, as an old pupil of Mr. Royce, he took this opportunity of publicly expressing his gratitude to him.

Mr. ROYCE: He expressed his appreciation of the honour the Society had done him—an honour which he felt he did not fully deserve.

THE DEVELOPMENT AND PROGRESS OF THE AERO ENGINE

BY

MR. H. R. RICARDO, F.R.S., F.R.AE.S., M.I.A.E., ASSOC.M.INST.C.E.

The possibility of sustained flight by heavier-than-air-machines was fully recognised during the last century by those who had studied the aerodynamic problems involved and it was realised that its accomplishment awaited only the development of a prime mover of sufficiently light weight.

Of all the known forms of prime mover, the internal combustion engine alone held out any promise of fulfilling the conditions necessary for sustained flight, namely, light weight not only of the engine itself but also of the fuel it consumes. Early attempts had, however, been made to fly with steam propulsion and it is of interest to note that the very remarkable and cleverly-designed steam plant employed by Sir Hiram Maxim in 1894 was actually very considerably lighter per h.p., even including the boiler and condenser, than the petrol engine used successfully some nine years later by the Wright Brothers. Although, in the last century, short flights would have been possible with the aid of the steam engine, yet with so hungry and thirsty a creature, prolonged flight was quite out of the question, on the grounds of catering alone.

The rapid progress of the internal combustion engine during the last fifty years has been one of the most remarkable developments of mechanical engineering. Fifty years ago, its minimum weight was about 500 pounds per h.p. and its use in consequence was restricted solely to stationary purposes. Forty years ago it had dropped to about 75 pounds per horse-power, and its use for road transport began to develop. Thirty years ago its maximum weight had dropped to about 10 pounds per h.p.—by this time it had already begun to revolutionise road transport and the victory of the air was close at hand. Twenty years ago its weight could be reduced to three pounds per h.p. and flight had become an accomplished fact. Since that date the minimum weight had dropped further to a little over 1½ pounds per h.p. and in the case of racing engines to well below one pound.

The achievement of flight made its deepest impression in France and it was France alone who, during the first few years after the Wright Brothers' success, grasped the immense future of aviation and at once devoted her best talent to the development of suitable engines. Of these early developments the most brilliant, the most original and the most daring example was the 50 h.p. Gnome engine designed by Monsieur Seguin. This remarkable engine, which was actually in use as early as 1907, weighed less than three pounds per h.p.; it was quickly followed by a larger version in which the weight was further reduced to but little over two pounds per h.p., and this, in turn, was followed by the Gnome Monosoupape engine, an even more daring design by the same author. In the Gnome engine we have an example of a complete departure from all past experience and tradition, such as has seldom occurred in any engineering development. Of other engines designed and produced in France solely and specifically for aircraft during these early days, one may cite such examples as Le Rhone, Clerget, Canton-Unne, Renault, Anzani, and many others to indicate the great confidence which France and the French manufacturers placed in the future of aviation. During the same period we, in England, made only very half-hearted and sporadic attempts to produce an engine suitable for aircraft. Doubts as to the commercial future and the belief ingrained in all English engineers that after

oak, cast-iron was the bulwark of Great Britain, combined to hinder development in this country. It was not in fact until halfway through the Great War that we were able finally to break with the cast-iron habit and to abandon a material which had served our forefathers so well for lamp-posts and kitchen ranges.

During the war, the aero engine underwent a period of intensive development to which was devoted all the best talent of the countries concerned together with unlimited resources of every kind. We, in this country, entered the war with only one engine with any considerable flying experience to its credit, namely, the much-abused, but very serviceable R.A.F. engine, and we were forced, at the start, to rely almost entirely on our ally, France, for the supply of designs and experience, but it is satisfactory to record that before the end of the war the position had been reversed and that English-designed and English-built engines were in the ascendancy.

Since the war progress has been steady; for the last ten years it has taken the form of improving and consolidating existing design, and there have been few startling developments. During this period the power output of a given size of engine has been increased by an average of about 40 per cent., thanks, in part, to improved knowledge of the thermodynamic and other problems involved, in part to progress in metallurgy and to the use of more suitable fuels, but mainly to meticulously careful design, and the daily application of an ever-widening experience in service. The power-weight ratio has not, however, fallen to the same extent because demands in other directions, such as smoothness of running, a longer working life and refinement generally have in every case caused the same engine to put on flesh as the years roll by. To-day the modern aero engine is not only about the most efficient prime mover in existence, but it is also one of the most reliable.

If we review the progress of engineering in the past we find that each new line of development starts of course with a period of experiment and groping, during which a wide range of types is evolved. By a process of elimination this range is very soon whittled to one or two survivors; in the final choice of these survivors, chance plays often quite as important a part as merit. On the one or more survivors the attention of the whole engineering world is concentrated, with the result that step by step it is improved out of all recognition and reigns supreme until it reaches almost the very limit of its capacity when a new and fundamentally better type eventually replaces it. Such has been the history of the steam engine which fifty years ago had crystallised into an almost standard design of open-type, double-acting, slow-running engine; for many years this held undisputed sway until it was displaced by the enclosed high-speed vertical type; this again was perfected until it seemed almost final, only to be superseded in turn by the turbine. That this process is so prolonged and that the obsolete so long outlives its days is due to the fact that in every age the new-comer, in its raw and undeveloped state, is invariably pitted against the champion of the older school and challenged to defeat it in the first round. Allowance is seldom made for the fact that the reigning type has enjoyed the benefit of many years' experience under every conceivable condition, supplemented by the combined skill of the best talent in the country, while the new-comer, of course, lacks these advantages. Particularly does this apply to the question of reliability, for reliability is attained only by prolonged experience both in manufacture and in service, none of which are available to the new-comer. It is this attitude of mind, this want of imagination perhaps, which frequently delays progress and allows obsolete types to outlive their day, and it is an attitude which is particularly prevalent in this country.

Since the war the trend of aero engine design has settled down to two highly-developed types of poppet valve petrol engines, the air-cooled radial and the V-type, water-cooled engine, both of which have approached the extreme limit of their capabilities—what further scope is left for increase of power, reduction of weight, or improvement in economy can now be of a small order

only, and, by analogy from the past, it would seem that the time is almost ripe for some innovation more radical than mere detail improvement. Fig. 1 shows in graphic form the improvement in power-weight ratio of the four leading British engines during the last ten years, from which it will be seen that the curve has already almost flattened out. Power-weight ratio of the engine alone is not, of course, by any means the sole criterion; fuel economy is to-day of equal and in many cases even greater importance, but here also the curve appears to have flattened out. The average test-bed consumption figure of the engines submitted to the Army and Navy competition tests in 1914 was 0.78 pounds per b.h.p. hour, that of the best 0.65 pounds. The average consumption of aero engines under similar test conditions in 1922 was about 0.55 pounds and that of the best about 0.48 pounds. The average consumption to-day is about 0.52 pounds and of the best examples about 0.46 pounds. It may be argued that the performance of the Rolls-Royce and Napier engines which performed so magnificently in the last two Schneider Trophy races belies what I have just said, but it will, I think, be admitted that the superb performance of these engines was

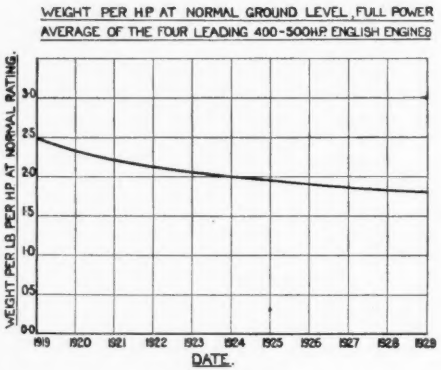

FIG. 1.

attained not so much by improvements which could be incorporated in the normal type, but rather by the use of expedients rendered possible by the conditions of the race, chief of which was the use of specially prepared fuel, and by encroachments on the margin of safety. It must be remembered that the same skill and the same experience is available to the standard Napier and Rolls-Royce engines as to the winners of the Schneider Trophy, yet that skill and experience has not evoked any very startling improvement in the standard engines produced by the same makers. In other words, the remarkable vigour of racing engines is produced by stimulants rather than physique.

We have seen that during the past twelve years the average power output of aero engines of given cylinder capacity has increased by about 40 per cent. and it is worth while to try and analyse the progressive steps by which this improvement has been attained. In the first place there has been an all-round increase of nearly 20 per cent. in the mean effective pressure—this has been attained in part by detail improvements in valve design and operation; in part by the use of a higher compression ratio rendered possible by improvements in the fuel, and in part by improved knowledge of combustion chamber design. There has been an all-round increase in the rotational speed of rather over 20 per cent., brought about by improvements in materials, in mechanical design and in the technique of manufacture, and lastly, there has been an improvement of well over 100 per cent. in the life of the engine between overhauls brought about by

extensive experience and meticulous attention to detail. Every increment of power has added both to the dynamic and to the heat stresses and has had step by step to be met by improvements in cooling, in lubrication, in material and in structural stiffness. Each step has revealed the presence of some weak link in the mechanism and a halt has had to be called till that link could be strengthened, thus the process has continued, for ever halting to overhaul the chain until ultimately every link will be of equal strength and the limit of the type will be attained. At one step the valve mechanism sets a limit to our speed; next it is the connecting-rod big-end bearing which is overloaded; at the next step the exhaust valve is overheated, or it may be the sparking plug; next detonation intrudes, and so, little by little, fighting every obstacle as it arises, the existing types of aero engines are improved until to-day they represent the very summit of engineering skill.

The improvement in engine performance during the past ten years is due, in no small measure, to the improvement which has been effected in the quality of the fuel, in particular as regards its tendency to detonate. Less than twenty years ago, practically nothing was known about the behaviour of different hydro-carbon fuels; petrol was just any volatile petroleum distillate and was defined by its specific gravity and nothing else. Detonation, which we now take so seriously, and which sets a limit to the ratio of compression we can use, was unknown as such, and was regarded as a form of pre-ignition; this, in turn, was regarded as an evil, for which the engine designer was solely to blame through inadequate cooling.

That the phenomenon of detonation and pre-ignition could be confused was not altogether surprising, for both reacted similarly to the same treatment, that is, better cooling, but when a few years before the war benzole was introduced and detonation disappeared while pre-ignition remained, it became apparent that the two phenomena were quite distinct and that one at least was affected by the fuel. Once this had been observed, the Shell Company instigated a very thorough investigation both into the cause and phenomena of detonation and into the individual behaviour of the various petroleum products. This research was necessarily postponed until after the war, but it very soon revealed that detonation was a phenomenon totally different from pre-ignition and one which depended primarily upon the chemical composition of the fuel.

Petrol, as such, consists of a mixture of hydro-carbons of three series, aromatics, naphthenes and paraffins in varying proportions, depending on the locality of the oil wells. Of these, the former, of which the best known members are benzole and toluene, are the least prone to detonate, while the paraffins are the worst offenders. It was found that by increasing the proportion of aromatics —by suitable blending—detonation could be reduced enormously and much higher ratios of compression could be used with a corresponding gain in power output and efficiency.

Looking back over the last twelve years we find that the general improvement in the fuels resulting from better knowledge of the behaviour of their several constituents has accounted for an all-round increase in power output and economy of from 10 to 15 per cent., due to the higher ratios of compression which can now be used. Of the 40 per cent. increase in power gained during the last ten years from 10 to 15 per cent. is due, therefore, to the general all-round improvement in the fuels available.

It so happens that the aromatic series of hydro-carbons have a high specific gravity, and since the merit of petrol was formally judged by gravity alone, fuels rich in aromatics were considered as inferior petrols. So strong was this belief that for several years the whole of the output of petrol from the vast oilfields of Borneo was piped out into the forest and burnt; thus thousands upon thousands of tons of the very finest petrol in the world were wantonly destroyed.

More recently it has been discovered that certain metals such as lead, thallium and others, suppress detonation when administered even in minute doses, due, it is believed, to their avidity for oxygen, which induces them to rob the unstable peroxides which are present as an intermediate product of combustion and whose instability is the primary cause of detonation. Clearly we cannot in practice introduce metal in a sufficiently finely divided form into the cylinder of an engine and a suitable compound must be found which is soluble in petrol and which will break down, by dissociation, after its entry to the cylinder. We have also to face the difficulty of getting rid of the metallic oxide left over after combustion. Of the suitable metallic compounds, lead tetra ethyl is the best known; this fulfils the required conditions both as regards solubility in petrol and as regards dissociation at an appropriate temperature, while the residual oxide can, to some extent, be carried away by the addition of ethylene dibromide, but to some extent only—with the use of this mixture there is still some residual deposit left and this is liable to break down the insulation of the sparking-plug; hence the use of these anti-detonating metallic dopes is limited to very small doses or to special occasions only.

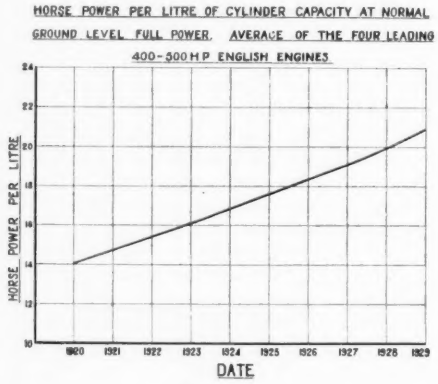

FIG. 2.

Air v. Water-Cooling

Since flight first started controversy has raged as to the relative merits of air *versus* water-cooled engines and to-day we are no nearer settlement. In England and in America a slight preference is shown for the air-cooled engine; in France, Germany and Italy there is a slight preference for the water-cooled engine. The advantages of the air-cooled engine are so obvious as, at first sight, to appear almost overwhelming.

(1) It is far less vulnerable;

(2) It is lighter; in actual fact the dry weight of both air- and water-cooled engines is exactly the same; hence, the water-cooled engine is the heavier to the extent of the water and radiator it must carry.

(3) It is completely immune from all " plumbing " troubles to which the water-cooled engine is very susceptible.

(4) It cannot be damaged by frost.

The disadvantages attached to air-cooling are:—

(1) As yet only one successful type of air-cooled engine of large power has been produced, namely, the radial type. As the power output

of this type increases so also does its already considerable frontal area and the advantage gained in the way of reduced weight is more than offset by increased head resistance. This does not apply to the water-cooled engine to anything like the same extent.

(2) In any internal combustion engine the intensity of heat flow is greatest at certain localised points such as the immediate surroundings of the exhaust valves and sparking-plug. In the water-cooled engine heat can be transferred from any local point at an almost limitless rate, but in the air-cooled engine this is not the case, with the result that to avoid local overheating the air-cooled engine has to expend far more energy on cooling itself, in order to scoop the heat out of a few odd recesses; even so, the air-cooled engine is forced to work at a lower efficiency and with more lavish lubrication.

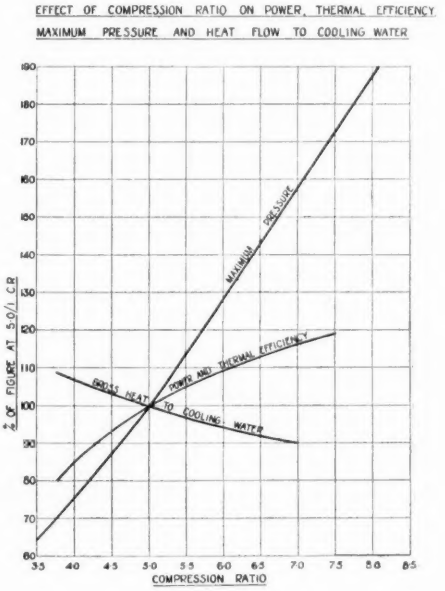

FIG. 3.

From the time when flight first started till the present day, the scales have failed to show any decided tilt towards air- or water-cooling. It is, perhaps, significant that air-cooled engines predominate in those countries where frost is of frequent occurrence, and water-cooled engines elsewhere, thus indicating that, in practice, the least important of the advantages is sufficient to tilt the scale. While the more extensive use of high conductivity aluminium cylinder heads tends to widen the scope of air-cooled engines, the use of steam cooling, and perhaps also the use of liquids of higher boiling and lower freezing points such as ethylene glycol give a corresponding leg up to the water-cooled engine. Steam cooling in particular appears most attractive in that it is far less vulnerable, while not only can the surface of the radiator or condenser be reduced, but it can be placed anywhere and made in any convenient and streamline form; thus the leading edge of the wings may be utilised as the condenser surface. The only real advantage I can see in favour of the use of ethylene glycol lies in its low freezing point,

for little or nothing is to be gained from its higher boiling point seeing that the boiling point of water is quite as high a temperature as is wholesome; for any higher temperature results merely in loss of power and an increased tendency to heat troubles such as gummed-up piston rings, etc.

It is perhaps worth while to consider what scope is left for improvement of aero engines of the present generally-accepted types. The power output of any engine is a product of the weight of air it can consume in unit time and of the efficiency with which it can be utilised. With engines of conventional type we can increase the efficiency only by the use of higher ratios of compression, but in this direction we are limited in part by the fuel and in part by the fact that as we increase the compression ratio the gain in efficiency diminishes, while the increase in maximum pressure rises alarmingly. Fig. 3 shows the percentage gain in power output as we increase the compression ratio from 4 to 8:1, and

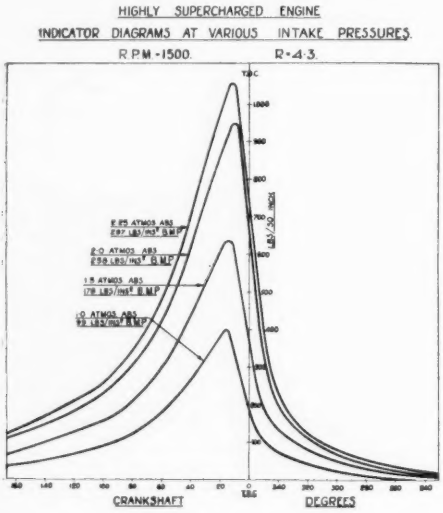

FIG. 4.

also the corresponding maximum pressures involved. We are nearing the point at which the increase in maximum pressure will necessitate so much additional weight to and involve so much more friction in the moving parts as to neutralise the gain in power and economy.

We can increase the weight of air taken into the cylinder by:—

(1) Using oversize cylinders and working them at full capacity at high altitudes only;

(2) Increasing the speed and so filling the same cylinder more frequently; or

(3) By supercharging and so overfilling the cylinder.

The use of over-size and under-filled cylinders has never proved very successful in practice because it is the dynamic loading rather than the gas pressure which, at the reasonably low pressures used in petrol engines, decides their scantlings and dimensions with the result that the over-size cylinders are liable to involve an over-size engine generally and the advantage is lost.

The second alternative, namely, increase in speed, involves a large increase in the dynamic forces which vary as the square of the speed. This, in turn, can be met by the use of smaller cylinders in larger numbers and the trend of development is certainly in this direction, but is limited by the necessity for duplicate ignition systems which become increasingly heavy and complex as the number of cylinders is increased; the same objection applies also to carburation and distribution.

The third alternative, namely, supercharging, offers at present much the widest scope for power increase, since the weight of air dealt with can be supplemented to any extent without increasing the dynamic forces, but unfortunately, only at the cost of a very large increase in the heat stresses, some loss in fuel

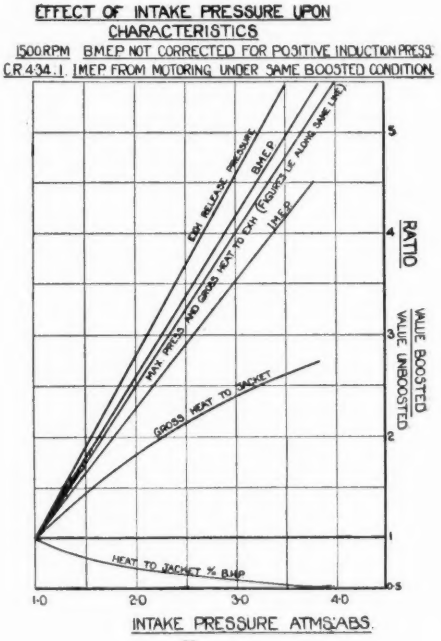

FIG. 5.

economy and a great increase in the tendency to detonate. In Fig. 5 are shown the variations in :—

(1) Power output;
(2) Maximum cylinder pressure;
(3) Heat flow to the jackets;
(4) Heat flow to the exhaust;
(5) Pressure against which the exhaust valve has to open as observed over a range from 1 to 3 atmospheres.

In the poppet-valve engine of to-day the exhaust valve is the weakest link in the chain and it is the strain on this link in particular which is accentuated so enormously by supercharging.

As yet and apart from racing engines no one has, by supercharging, succeeded in increasing the ground level power of aero engines using ordinary

aviation fuels by more than about 10 per cent., the limit being set by the intrusion of detonation and pre-ignition arising from the overheated exhaust valve and plug points. In the case of racing engines very special fuel mixtures can be prepared which will resist detonation and thus allow of the combination of supercharging and a high compression ratio and so greatly relieve the distress of the exhaust valve. Although the presence of the exhaust valve forbids at present the use of any substantial increase by supercharging on the ground, this, of course, does not apply at high altitudes, where the supercharger may be used to restore ground level pressure in the cylinder and it is in this direction of maintaining ground level power at altitude rather than an all-round increase in power that supercharging is employed, and to this it must probably be restricted so long as the exhaust valve is with us.

Three general systems of supercharging have been tried:—

(1) The exhaust-driven centrifugal blower;
(2) The gear-driven centrifugal blower; and
(3) The positive displacement type blower.

Of these the exhaust-driven blower was developed actively, both during and just after the War; it appears at first sight to be the most attractive, since the waste energy in the exhaust gases can be utilised. In practice, however, it has proved very disappointing; in the first place, the efficiency of the turbo blower is too low with the result that the loss due to back pressure on the exhaust is equal to, if not greater than, that of driving the blower by gearing, while the festoons of red-hot exhaust pipes add to the head resistance of the machine and increase greatly the fire risk.

The exhaust-driven fan has now been superseded by the gear-driven type with which ground level density can, if required, be maintained up to an altitude of over 12,000 feet, while in very extreme cases, such as that of the Rolls-Royce Schneider Trophy racer, a pressure as high as 14 pounds per square inch above atmosphere has been maintained in the induction pipe, but this was assisted by the forward speed of the machine which, coaxed by a suitable orifice, contributed about 3 pounds per square inch.

In America, the displacement type blower has been used, experimentally at all events, with considerable success. This type would appear to have some decided advantages. In the first place, it runs at a relatively low speed, hence the gearing problem is greatly simplified; its efficiency is at all times very slightly greater than that of the centrifugal type, and it is capable of a higher pressure if and when required; lastly, the power absorbed by the blower when not in service, or when operating at low pressure, is considerably less. The design and manufacture, however, of a displacement type blower involve some very difficult mechanical problems, necessitating the use of very small clearances in a piece of mechanism of large dimensions, liable to distortion and subjected to considerable changes of temperature.

Apart from its use in augmenting the power output, the supercharger plays a valuable part in assisting carburation and distribution. In a multi-cylinder engine the number of carburettors can be reduced and the induction pipe work simplified very considerably.

Sleeve Valve Engines

Throughout the whole life history of the four-cycle internal combustion engine the exhaust valve has always been the weakest link in the chain. This valve is called upon to operate under exceptionally severe conditions both as regards temperature and mechanical stresses and in recent years it is almost true to say that the power output of the petrol engine has increased year by year by just the extent to which the metallurgist has improved the material of this

critical member. The metallurgist is now probably near the end of his tether and, in any event, the working temperature of the exhaust valve head has now attained so high a level as to promote appreciable surface combustion during the suction and compression strokes of the engine, thus not only wasting a small proportion of the fuel, but what is far more serious, raising the whole cycle temperature and thereby increasing the tendency to detonate. If to cool the exhaust valve we increase the ratio of expansion we at once increase the tendency of a normal fuel to detonate. If we reduce the ratio, we increase the temperature of the exhaust. Thus, a vicious circle is set up from which there seems no escape so long as we tolerate within the combustion chamber a member whose surface is considerable and whose temperature is far above the self-ignition temperature of the fuel. If, therefore, we are to look forward to any substantial increase in performance or to the application of supercharging for purposes other than altitude compensation, we must first abolish the exhaust valve. In the light of present knowledge the only practicable alternative would appear to be the single sleeve valve. This mechanism has also other advantages. In the first place, it is controlled mechanically throughout its whole movement instead of in part mechanically and, in part, spring-operated as in the case of the poppet valve; moreover, since its velocity is almost uniform there are no appreciable acceleration forces for the mechanism to contend with; hence, so far as the valve gear is concerned, the engine speed may be almost unlimited. The absence of any hot surface in the combustion chamber allows of a much higher ratio of compression ratio being used actually about one whole ratio higher or conversely it permits the use of inferior fuels.

Lastly since the engine breathes through gills rather than nostrils, neither the shape nor the cooling of the head need be cumbered by the organs of respiration.

As I have mentioned previously, our best hope of reducing weight lies in the application of supercharging, not only as an altitude correction, but to give an all-round increase in power. The exhaust valve, however, forbids any large increase in ground level horse-power except when, as in the case of last year's Schneider Trophy races, a very special fuel is employed. With the single sleeve valve engine there is no such limitation and an experimental single sleeve engine has been run heavily supercharged for several hundred hours on ordinary aviation spirit at a brake mean pressure of over 400 pounds per square inch and at a specific output nearly three times greater than that of any aero engine now in service, and that without the least sign of distress or overheating of the sleeve valve. With a fuel comparable with that used in the Schneider Trophy, the same engine will maintain a brake mean pressure of 550 pounds per square inch when the specific output is almost double that of last year's Schneider Trophy winner. With high degrees of supercharge the energy available in the exhaust becomes so large as once again to bring into prominence the vexed question of compounding. In the case I have just cited the exhaust is discharged from the cylinder at a pressure of well over 300 pounds per square inch and, as such, is capable of doing again almost as much work in a low-pressure cylinder as it has done already in the high pressure. In the case of the poppet-valve engine, compounding is not worth the candle, because the exhaust valve cannot in any event be made to operate under such severe conditions, while the mechanical and other problems connected with the design of a suitable transfer valve from the high to the low-pressure cylinder appear to be almost insuperable. With the sleeve valve, however, compounding becomes comparatively easy because the same valve can be arranged to operate both as the inlet and exhaust valve to the high pressure and as the inlet valve to the low-pressure cylinder. By compounding in this manner it should be possible not only considerably to improve the economy but also to reduce weight since the cylinders which alone

have high pressure and temperature to deal with, can be made quite small while the low-pressure cylinder can be made very light. In a supercharged compound engine one would aim to do the bulk of the work in the two-cycle low-pressure cylinder and to use a pair of quite small high-pressure four-cycle cylinders both to take the bite off the pressure and temperature and to serve as valve gear for the low pressure.

I have enlarged on the question of the single sleeve valve because its use would appear to open up new possibilities unattainable with the poppet-valve engine. In the case of water-cooled engines it would seem that the sleeve valve could be substituted for the poppet valve without any material difficulty or additional weight.

In the case of air-cooled engines, however, the problem of cooling the hollow cylinder head of a sleeve valve engine is likely to prove difficult and very little experience is as yet available.

It has been shown, experimentally, that the sleeve valve engine is capable of a far greater power output than is attainable from any design of poppet-valve engine yet in sight, but I would like again to emphasise that while the high duty sleeve valve engine is a possible new-comer, it must not be expected in its relatively undeveloped condition at once to outstrip the poppet-valve engines of the present day.

In the Army and Navy Competition of 1914, a single sleeve valve engine was entered and put up a very good performance—it failed through the breakage of its crankshaft, but its performance in every other respect called forth a warm tribute from the judges in their report.

Compression Ignition

During the last few years aero engine designers in every country have been turning their attention to the compression ignition or heavy oil engine.

The principal arguments in favour of this engine are:—

(1) The elimination, or at all events the enormous reduction, in the fire risk;
(2) Much better fuel economy;
(3) The elimination of electric ignition and thus of interference with wireless communication;
(4) The use of a cheaper fuel.

These are all weighty arguments and sufficient to justify the large amount of thought and research which is now being lavished over the problem.

The heavy oil engine was evolved and developed by the last generation as a slow-running engine for heavy industrial work and its secrets had been so jealously guarded by the last generation and so enshrouded in mystery that for many years none dared tear aside the veil and reveal it as it is—a very commonplace type of heat engine. For twenty years its high priests have assured us that it would work only at a leisurely gait and that it was sheer impudence even to suggest a high speed version. A few mischievous spirits had made timid attempts to hustle it, but it was not until nine years ago that the Royal Aircraft Establishment stepped boldly in and showed that, treated rough, it could step quite as lively as any other heat engine. To the Royal Aircraft Establishment is due the credit of having first shown the world that the high speed heavy oil engine was not only a practical possibility but that it could actually be made more efficient than its clumsy prototype. The pioneer work by the R.A.E. was soon followed up by other experimenters until to-day, almost every aero engine builder throughout the world is experimenting with the heavy oil aero engine and in almost every case he is finding the problem far less difficult than he had expected. In two quite recent papers I have discussed fairly fully the question

of combustion in heavy oil engines and will not now attempt to do more than summarise the conclusions. In the high speed compression ignition engine with what is termed solid injection, combustion appears to take place in three distinct phases. First, a delay period during which fuel is admitted to the cylinder but either fails to ignite or burns only from one or more minute nuclei; secondly, a period of rapid pressure rise during which the fuel which has already been injected burns rapidly at a rate determined by the degree of turbulence within the cylinder; this continues until the pressure and temperature have reached so high a figure that the remainder of the fuel can burn as it issues from the injector. During the first two phases the pressure rise is largely out of direct mechanical control, but, during the last phase, it is controlled entirely by the rate of injection from the fuel pump. The smaller the cylinder, or the higher the speed, the longer the delay period, hence more fuel is burnt under the condition of phase two and the maximum pressure is higher. Thus, while a 5½in. cylinder working at 1,500 r.p.m. will give a certain performance at a maximum pressure of 750 pounds per square inch, to get the same performance at 2,400 r.p.m. we have to let the maximum pressure rise to about 850 pounds per square inch. Again, if we reduce from 5½in. to say 4in. we shall have to let the maximum pressure rise by nearly 100 pounds per square inch to obtain the same performance.

In order to obtain the necessary rapid and complete combustion, it is essential that the relative motion between the droplets of liquid fuel and the air within the combustion chamber shall be extremely rapid. Such rapid relative motion can be attained either by shooting the fuel through the air at a very high velocity or by making the air within the cylinder rush past the entering stream of fuel. The former method involves very high injection pressures, very small orifices and accurate aiming of the several fuel jets, the latter method obviates these difficulties and allows of low pressure injection through a single hole orifice of relatively large dimensions. It has the advantage, also, that it is almost completely immune from mechanical obstruction or disturbance. In order, however, to acquire the necessary rapid and orderly rotational flow of the air, it is essential to admit it tangentially to the cylinder and as near the circumference as possible; in other words, through ports in the cylinder wall. This can be accomplished easily enough by the sleeve valve, or by the ports in a two-cycle engine, but it is by no means easy to achieve the same result with poppet valves. It would seem, therefore, that the sleeve renders possible a very simple, light and reliable form of heavy oil engine. On account of the lower mean pressure and also of the unfavourable ratio of mean to maximum pressure the four-cycle heavy oil engine must, of necessity, be considerably heavier than a petrol engine of similar design. From careful analysis of the various factors it would appear that given equal skill in design and manufacture, the heavy oil engine will be some 50 per cent. heavier than a petrol engine of the same power output and of similar general design. The compression ignition engine is, however, admirably fitted to work on the two-stroke cycle and there seems no fundamental reason why a two-cycle heavy oil engine should not be developed whose weight would approach very nearly that of a contemporary petrol engine of the same output. With regard to fuel consumption and range, the best petrol engines of to-day show a fuel consumption on the test bed of about 0.46 pounds per b.h.p. hour while the best experimental light heavy oil engines show 0.35 pounds per b.h.p. hour; this, however, is by no means a fair basis of comparison, for while the petrol engine may, with advantage, and in flight invariably does consume fully 20 per cent. of excess fuel the compression ignition engine maintains always its maximum efficiency and, in fact, cannot do otherwise. We ought, therefore, to compare a petrol engine with a consumption of 0.55 pounds with a heavy oil engine consumption of 0.35 pounds, a difference of 0.2 pounds per

b.h.p. hour in favour of the latter. If we take the weights of the fully equipped engines as two pounds and three pounds per h.p. respectively we find that the heavy oil engine will begin to score when the range exceeds five hours. Just recently the Packard Company of America have produced successfully a small radial air-cooled heavy oil engine of quite exceptionally ingenious mechanical design, the weight of which is said to be little over $2\frac{1}{4}$ pounds per h.p.—a very fine achievement. To accomplish this, however, the reduction gear usually fitted to so high speed an engine has been omitted and it would also appear that the margin of safety has been encroached upon considerably. There is little doubt but that a petrol engine of similar design and with the same margin of safety would weigh less than $1\frac{1}{2}$ pounds per h.p.

While on the one hand it may not be long before heavy oil engines will take the air in considerable numbers yet I cannot see that they will oust the petrol engine; rather, I think, each will find its own sphere of usefulness for many years to come.

The intensive research which has been carried out during the last few years on heavy oil engines has naturally thrown fresh light on certain of the problems connected with petrol engines particularly as regards fuel distribution to the several cylinders. The petrol engine of to-day uses a carburettor and from it distributes a mixture of partially vaporised fuel and air to the various cylinders. In the event of any cylinder receiving a weak and slow burning mixture flame lingers in the combustion chamber throughout the exhaust stroke, with the result that on the opening of the inlet valve the whole mixture in the induction pipe is ignited and what is known as a backfire occurs; this is always alarming to the pilot and sometimes even dangerous. To avoid risk of backfire or of losing his engine when opening up after idling, the pilot invariably works with a somewhat rich mixture which is very wasteful in fuel.

The system of distributing a partially vaporised mixture to a bank of cylinders has been in vogue since the petrol engine first appeared and though its evils are recognised they have come to be accepted as inevitable. The alternative system of injecting into each cylinder an accurately measured quantity of liquid fuel has generally been considered as altogether too difficult even to attempt. In the case of the heavy oil engine, however, this problem has had to be solved and has, in fact, presented far less difficulty than anyone would have dared to predict. Some thirteen years ago the late Major Norman carried out some very promising experiments along these lines and but for his untimely death they would probably have been brought to a successful issue. Some five years ago and after a good deal of experience with injection problems in heavy oil engines a long series of experiments on similar lines were again put in hand when it was found that both a higher power output and cooler running could be obtained when the fuel was injected during the suction stroke, since the whole of the latent heat of evaporation of the fuel was available within the cylinder both to cool the latter and to lower the temperature and so increase the density of the entering air. It was found, as would be expected, that weaker mixtures could be used with, of course, complete immunity from any risk of backfiring. Experiment also showed that with the sleeve valve engine advantage could be taken to secure some measure of stratification and so realise a still further economy. Yet further experiment revealed that when the fuel was finely pulverised by injection under higher pressure, safety fuels of high flash point could be utilised. Fuel consumption as low as 0.41 pounds per h.p. and brake mean pressure as high as 150 pounds per square inch could by such means be obtained in a relatively low compression petrol engine without any increase of weight at all. Quite recently Hesselman has produced an engine in which the fuel is injected under high pressure towards the end of the compression stroke and immediately before ignition; by such means he is able to use still heavier fuels, but since the fuel is injected after the inlet valve is closed, the latent heat of evaporation is no

longer available for increasing the air charge and the power output is, in consequence, reduced considerably.

I have endeavoured to outline some of the directions in which a departure from orthodox practice might usefully be considered; further than that I will not attempt. The prophet of old had an easy time; he was free to predict whatever came into his head, but was generally able to ensure that only his good shots were remembered. The prophet of to-day has no such easy task, for all his predictions are recorded. In the race for the best aero engine I am prepared to suggest some of the possible runners, but I will not attempt to spot the winner.

In conclusion, I would like to thank both the various aero-builders and the Research Department of the Air Ministry for all the assistance they have given in the way of provision of data, loan of lantern slides, etc.

Mr. H. E. WIMPERIS (a Vice-President of the Society and the Director of Scientific Research at the Air Ministry): In proposing a vote of thanks to Mr. Ricardo for his lecture, he said that the Society had had the privilege of listening to a survey, by a master of the art, of the development of the internal combustion engine, particularly as applied to aircraft. It would be agreed by all that Mr. Ricardo was a very fitting successor in the line of eminent Wilbur Wright Memorial lecturers—the eighteenth in that succession. The memory of Wilbur Wright and his brother, Orville Wright, was kept alive by these successive lectures, and no field of work was more important to the furtherance of their original wishes than the field that had been surveyed by Mr. Ricardo. It was difficult to cast one's mind back to 1903, when the Brothers Wright had made their first power-driven flight in a heavier-than-air craft. He (Mr. Wimperis) could remember, however, an occasion about five years before that time. On that occasion he was a student at the Imperial College of Science, and he had heard that great teacher, Professor Perry, say that he felt sure the internal combustion engine had got to the point, and our knowledge of the forces on aerofoil surfaces had got to the point, at which all that was really needed was that some young men should begin experimenting practically on what was then known, and apply their ingenuity to the purposes of flight. Five years later that was achieved by the Brothers Wright.

Mr. Ricardo, continued Mr. Wimperis, was a very young man to hold a position so eminent as that which he held in the field he had chosen for his activities. He (Mr. Wimperis) had first met him many years ago, when he had been interested in, and in fact had produced, a motor car engine which had flap valves. It was a two-cycle engine. Even in those " prehistoric " days his interests had been very much tied up with the valve. He had then turned from that " flapper " to the single-sleeve valve, and he had made the old poppet valve—which in his lecture he had made the " prisoner in the dock "—feel very small and very hot, as, indeed, it was. He had made out a very good case for the single-sleeve valve—on which a good deal of money was being spent and to which much experiment was being devoted. The great skill which he had brought to bear upon his subject—as was evidenced by his discovery (not invention) of detonation and his advocacy of supercharging—and his great ingenuity were such as would bring him through the difficulties that were bound to be encountered in the efforts being made to use the sleeve valve and produce results such as he had mentioned in his lecture, where he had referred to a b.m.p. of over 400 lbs. per square inch having been obtained. He was very fortunate in having at Shoreham a quiet retreat in which to work, and all the money he could want to enable him to do exactly the work which lay nearest to his heart. One wondered whether, when Mr. Ricardo had chosen his charming retreat, he had read Robert Louis Stephenson's " Life of Professor Fleeming Jenkin." Stevenson had quoted Jenkin as having said, after he had moved

away from London to enter such a retreat: " It is well enough to fight and scheme and puzzle about in the eager crowd here in London for a while now and then, but not for a lifetime. What I have now is just perfect." Mr. Ricardo also had what was just perfect in the facilities he had. He was one of the alchemists who was engaged in the conversion of mere gold into knowledge, and one knew of no alchemist who served the Air Ministry who worked with higher efficiency in that direction than did Mr. Ricardo. In the early part of his lecture Mr. Ricardo had made the important observation that the time was almost ripe for some innovation more radical than mere detail improvement. With that Mr. Wimperis agreed entirely; he felt sure that the next ten years would show a very great advance in the aero engine—far greater than had been shown in the past ten years, great though that advance had been.

It was a very great pleasure to propose that a very hearty vote of thanks be accorded Mr. Ricardo for his most charming, able and witty address.

Mr. L. St. L. Pendred (President of the Institution of Mechanical Engineers): He was thankful for the invitation to second the vote of thanks to Mr. Ricardo, because it gave him the opportunity, on behalf of the Institution of Mechanical Engineers—and he felt sure he was speaking for other bodies—to congratulate the Royal Aeronautical Society on the 65 years of great work that it had done, and on its establishment of the Wilbur Wright Lecture in memory of a very gallant pioneer. He liked to think that the invitation to the President of the Institution of Mechanical Engineers to second the vote of thanks was due to the Royal Aeronautical Society, in recognition of the fact that mechanical engineering was a single unity and not a heterogeneity of units. There was a tendency of late, as many must have noticed, towards rather too much vertical specialisation. There were so many branches in engineering that engineers tended rather to get into what had come to be recognised as a vertical groove, and had not that width of outlook that was so desirable. Even when listening to Mr. Ricardo's admirable lecture, and particularly his remarks about exhaust valves, he could not help thinking that possibly engineers had allowed themselves to be bound down a little too much by the thought that they must always handle metals. The aeroplane people had got away from that for a time and had used wood, but they were coming back again to metal. Was it not possible that if engineers looked sideways, instead of along the vertical line which bound them always, some other material than metal—quartz, glass, or something else totally different from metal—might be found which would meet the requirements of the exhaust valve? A few evenings ago, at the Soiree of the Royal Society, Professor Watson had spoken on the subject of the pterodactyl—not Captain G. T. R. Hill's pterodactyl, but the real pterodactyl. Was it also possible, as Professor Watson had indicated, that aeronautical engineers must look even so much sideways as into palæontology in order to get hints as to what they should do? The great work which the Society was doing was essentially a part of mechanical engineering. Such work was " reciprocal " in its action. For instance, there was the problem of supercharging. It had begun, he believed, in order that aeroplanes might be able to take sufficient air into their cylinders at high altitudes. Since then it had come to earth. He was told that of the 71 motor cars which had taken part in the endurance trials at Brooklands a few weeks ago, 20 were fitted with superchargers. Of the great motor liners which crossed the Atlantic there were already something like eight or ten with supercharged engines. Another example of how features of one particular branch of engineering spread to others was to be seen in the work which was being done by a great steel firm for the Aeronautical Research Laboratory at the National Physical Laboratory. Some years ago Messrs. John Brown had developed a machine for rolling steel shells of relatively small diameter. The aeronautical people had asked the firm for something far larger than they had

ever done before, and to meet the requirements of the industry the firm were rolling cylinders 17 ft. in diameter, 2½ in. thick and 10 or 12 ft. long, which had been tested up to 450 lb. pressure per sq. in.

Mr. Pendred mentioned, as a matter of interest, that during a recent visit to America he had had the pleasure of meeting Orville Wright and of seeing him presented with the first Daniel Guggenheim Medal, which was awarded to him " for the design and construction—with his brother, now deceased—of the first successful engine-propelled airplane." It was unnecessary to say that the reception accorded to Orville Wright on that occasion was a very remarkable one.

Probably one of our human traits was that the things we admired most were those which we ourselves were least capable of performing. He felt the same emotion when listening to Mr. Ricardo's lecture. He and all other mechanical engineers would have liked to have done what Mr. Ricardo had done, and to have been able to deliver so good a Wilbur Wright lecture.

The vote of thanks to Mr. Ricardo was carried with enthusiasm and the meeting closed.

The meeting was followed by the Annual Council Dinner at the Athenæum. An account of the dinner and a list of those present appears in the Annual Summary of the Society's Activities printed in this issue.

THE AERODYNAMICS OF LEONARDO DA VINCI

BY

R. GIACOMELLI, A.F.R.Ae.S.

Foreword

Many books on aerodynamics are prefaced by a short historical introduction, in which, after having quoted Aristotle for his ideas on the motion of bodies through the air, and Newton, from whom aerodynamics is admitted to start, the name of Leonardo da Vinci is recorded, pointing out that he was the first to attribute to the resistance of the air the cause of the lift and flight of birds, recognising in the same resistance the possibility of solving the problem of flight.

But at the same time it is admitted that, interesting as have been his considerations on flight (and there is quoted his parachute, his helicopter, his flying machines and his observations on the birds), they can hardly be said to have been founded by him on an aerodynamical basis, which could only have been afforded by the modern development of science.

A propos of which I call attention to the fact that all that is said on the work of Leonardo da Vinci in aerodynamics is founded only on quite general impressions and not on a true and deep knowledge of the said work, as up to the present time no collection of his thoughts on the behaviour of the air towards bodies in motion through it, has been made.

The purpose of this paper is to collect all Da Vinci's writings on the matter in chronological order and to explain them suitably in modern language.

For the sake of ease of reading I have put the original text of Leonardo apart from my exposition. It must be remembered that with his manuscripts we have not to deal with a definitive and elaborate style of writing, but with notes put down in all haste and in the language of his time.[1]

His writings on the matter of resistance of air and in general of flight cover a period of twenty-five or thirty years, from 1486-90 to 1515. His first ones belong to the Codex B (1486 to 1490) and to that part of Codex Atlanticus which is contemporary with it, while other parts of the latter extend for all Leonardo's life. After these come successively: Codex Trivultianus (from 1487 to 1490), Codex A (1492), Codex M (between 1496 and 1500), Codex I (extending from 1497 to 1499), Codex L (extending perhaps from before 1500 to 1503), a successive part of Codex Atlanticus (extending from 1503 to 1505-06), Codex on the Flight of Birds (1505), Leicester Codex (extending from 1505 to 1508), Arundel Codex (of which a part was written in 1508, but other parts extend to all the life of Leonardo). In this part of the year 1508 many notes have been

[1] In a folio of Codex Atlanticus, referring probably to some critics of his writings, Leonardo drew out the following sketch of a proem to prefix to some of the numerous treatises on various matters which he intended to write and never wrote.

"*Procm.*

"I know very well, that not being myself a literary man some presumptuous men think they may blame me alleging that I am a man without letters. Foolish people! They do not know that I would be able to answer them, like as Marius to the Roman patricians, that I would be able to answer them, yes, telling them that they, while adorning themselves with the labours of others they do not want to allow me the merits of mine. They will say that as I know no letters, I am not able to say well that I wish to deal with. Now such people do not know that my things have to be drawn rather from experience than from the words of other people, which experience is master of those who wrote well, and this I take for my master and in all cases I will affirm it."—(Codex Atlanticus, folio 119 verso a).

copied by Leonardo from earlier notebooks of his without any change whatever, though his ideas during this time have been modified), Codex F (1508), Codex K (from 1505 to 1509), Codex G (extending from 1510 to 1515), and finally Codex E, which was the last notebook commenced by him and belonging to his last residence in Rome (from 1513 to 1515). Leonardo, who was born in 1452 in Vinci, as his name indicates, near Florence, died in 1519 in France, the guest of King Francis I.

Determination of the dates of Leonardo's writings is a very difficult task. Some of these Codices (Codex Atlanticus and the Arundel Codex) have been composed in a disordered manner by collectors from folios belonging to various epochs. For all Codices and their folios here considered I am indebted for determination of their dates to Mr. Gerolamo Calvi, of Milan, a recognised authority in this field, and for some particular indications about the Arundel Codex to Mons. Enrico Carusi, of Rome.

I come now to the importance attached by Leonardo to the study of the resistance of air, as a preliminary part of the general problem of flight, so that in his treatise on the flight of birds (where under this word he intended both flying creatures and flying machines) which Leonardo had in mind to write, the first chapter, or book of the same was to be dedicated to the resistance of air:—"*To speak of such a matter you have to define in the first book the resistance of air. . . .*"—(Codex F, folio 41, v. 1508.) The first mention of one treatise on the flight of birds, to be written by him, is made by Leonardo in a note in Codex K, folio 3 recto (1505-09), proposing a division of it into four books, in none of which mention is made of the necessity of prefixing the study of the resistance of air; but this note was afterwards cancelled by him. In Codex E (1513-15), at last, in the folio 54 v., a note is found in which the necessity is also indicated to prefix thereto the study of the "science of winds."

Therefore aerodynamics and aerology, to use modern expressions, constituted for Leonardo, as for us, a necessary introduction to the science of flight.[2] Before any beginning of my exposition I take pleasure in mentioning the very important study on "Leonardo da Vinci as a pioneer of aviation," and the valuable translation into English of "Leonardo da Vinci's manuscript on the Flight of Birds," which were published in the May and June, 1923, issues of the JOURNAL, by Mr. Ivor B. Hart, B.Sc., A.F.R.Ae.S.

THE PROBLEM OF LIFT IN LEONARDO'S MANUSCRIPTS (1486—1515)

The Problem Why Birds Fly, before Leonardo, did not Exist.—Both the aspects under which air exercises its action on bodies moving through it, *i.e.*, drag and lift, are considered by Leonardo in his manuscripts. But while the problem of lift was solved by him immediately so that his point of view on this subject, set down in his first manuscripts, remains the same in his last ones; that of drag, on the contrary, received by him a solution founded on the evidence of facts and experiments, only after having spent some twenty years in arguing and discussing along the lines of ancient philosophy.

Drag, in fact, is the more usual aspect of reaction of air, a general phenomenon felt by all bodies moving through it. It was a phenomenon observed for centuries and on which in Leonardo's time a number of opinions and thoughts had been accumulated, even arriving, on account of philosophical preconceptions, to conclusions quite contrary to the evidence of the experience and of the senses. These opinions had the result of hampering, with the weight of their authority, which came from Aristotle, any free investigation on the matter.

[2] A similar collection to the present one on Aerodynamics I made of Leonardo's passages relating to Aerology in a paper presented to the Fifth Air Congress at the Hague (1-6 September, 1930), entitled "The Aerological Study of the Wind in Leonardo da Vinci."

On the contrary, lift, being a special aspect of reaction of air, felt only by bodies of suitable form and in particular attitudes to the air, had not at all attracted the attention of anybody before Leonardo, so that no opinion or theory to be taken into account hampered the way to an examination of the question in full freedom of spirit.

Before Leonardo, indeed, nobody had tried to understand why birds flew. To be more exact, the lift of birds did not constitute a problem to be solved. Birds flew, of course, because they had the property of flight, according to the science of that time. And all that was done by that science in this direction was to say that birds, according to Aristotle in his treatise on animal locomotion, have their support on air, as ships have theirs on water. Apropos of which it was added (by way of comparison) that a certain analogy exists between the wings and tails of birds and the oars and rudders of ships.

Lift as the Result of Relative Velocity between Air and Wings.— The first to understand that the flight of birds was a problem to be explained mechanically was Leonardo. He thought that the lift of birds is the result of the relative velocity between air and wings, this velocity, if sufficiently high, being able to produce instantaneously a local compression of the air, caused by the pressure of the wings, and so being able to resist and support them.

As regards the degree of velocity necessary to give rise to this local compression, it was, according to Leonardo, such that a layer of air had to be struck by a wing with a velocity greater than the velocity with which the pressure can be transmitted from that layer to the back layers of air. In these conditions the air, not being able to escape from the very rapid pressure, compresses and acquires the nature of a solid body.

We have till now spoken of air struck by a wing, but everything remains the same, according to Leonardo, if, on the contrary, a wing is struck by air. In fact, lift being the effect of relative velocity between air and wings, it is exactly the same, whether a wing in motion strikes the air in repose, or air in motion (that is to say wind) strikes the motionless wing. This is the so-called principle of aerodynamical reciprocity, so extensively applied to-day in experimental aerodynamics, and which so many times is repeated by Leonardo in his manuscripts to establish the essential identity between flapping and soaring flight.

Certainly to have recognised that the flapping of wings was not essential for flying but only a means to obtain a velocity, which could also be obtained otherwise, that is by wind, is greatly to the credit of Leonardo, who by this alone showed that he fully understood the phenomenon of flight.

Compressibility as the Essential Property of Air as Regards Flight.— If lift is the result of relative velocity between the air and the wings, this is due to the fact, as has been said, that air under proper velocity of pressure is compressed. The possibility of air being compressed is for Leonardo, the fundamental condition for lift.

In all writings of Leonardo, from his first to his last, the entire theory of flight is founded on this basic property of air. "*Air is a body able to compress in itself,*" "*Air has the ability to compress and rarefy,*" "*Compression of air is in proportion to velocity,*" "*Air can be compressed and water not,*" "*To the air there is no inconvenience to be compressed and rarefied almost instantaneously, which is not possible with water,*" "*Air in itself is compressible and rarefiable to infinity.*" . . . Such are the expressions which we meet in all his manuscripts.

In Codex Trivultianus (1487-90) are found his first notes on compression of air under proper velocity pressure. These notes are of some interest also on account of the quaintness of Leonardo's expressions while explaining his air compression theory by means of very familiar and naive examples.

Air, he says in folio 6 v., if compressed with a velocity greater than is that of its escape, compresses, as bed feathers do under the pressure of a sleeper, and the object by which air has been compressed rebounds as a ball struck against a wall.[3]

And some folios after, in folio 23 v., Leonardo repeats that air owing to its compressibility, which is not shared by water, if struck with sufficient velocity compresses locally, thus impeding the bird's wing-tips to complete their course in flapping down. Therefore they are forced to rebound and the bird rises up, to the same extent the wing-tips could not perform their course in the same way as a man must do. who, pressing with his hands a resistant wall, is thrust back.[4]

A greater development of ideas is shown by Leonardo in successive passages belonging to the Codex Atlanticus. The first note is found in a folio (77 r.b.) the date of which can be assigned to the year 1503. The note is entitled, " Why birds keep up in the air." And the answer is that a portion of air, when struck by a body with a velocity greater than is that of its possible escape, compresses among other air, in the form of a cloud; this compression being in proportion to the velocity of the stroke. But if there is a wind, birds can keep up without beating wings, as the same action which is made by the wings on air in repose can also be performed by air on motionless wings.[5]

In the same Codex, perhaps two years later, at folio 161 r.a., Leonardo comes again to the question of the degree of velocity which is necessary to produce compression of air, *i.e.*, to give rise to lift, stating again the property of air to compress and rarefy.[6]

Among other observations regarding flight, there are in the same folio two notes, one stating that the motion communicated by a wing to its surrounding air is in proportion to its vicinity to it, and another stating that, owing to the diminution of air density with the height, birds are not able to keep up in great heights, if they do not take in with their wings a great extent of air.[7]

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[3] " When the force generates more velocity than the escape of the resisting air, the same air is compressed in the same way as bed feathers when compressed and crushed by a sleeper. And that object by which air was compressed, meeting resistance on it, rebounds in the same way as a ball striking against a wall."—(Codex Trivultianus, f. 6 v. 1487-90).

[4] " Air can be compressed and water not, and, when the movement by which it is compressed, is swifter than the escape of the same air that portion of air which is nearer to it becomes denser, therefore resists more, and when the motion made in it is swifter than the escape of the same air, its mover takes a contrary motion, as appears in birds, which not being able to send down the tips of their wings with that velocity with which they are moved by the force of their mover, it is necessary that the bird rises up to that extent for which the wing tips were not able to reach down; in the same way, a man who holds his breast near a wall and presses with his hands against this wall, if the wall does not give way, the man must come back."—(Codex Trivultianus, f. 23 v. 1487-90).

[5] " Why birds keep up upon the air. Air which with great velocity is struck by a body compresses an amount of itself, in proportion with that velocity . . . and therefore the air being a body able to compress in itself when it is struck by a motion of greater velocity than is that of its escape, it compresses within itself and makes itself through other air like as the cloud, that is, of that density. But when the bird is in a wind, it can keep up upon it without beating its wings, because the pressure is made by air against wings, these being motionless."—(Codex Atlanticus, f. 77 v.b. 1503).

[6] " If the motion of the wing which compressed the air is not greater than the escape of the compressed air, the latter will not compress below the wing, and therefore the bird will not keep up on the air. The air has the ability to compress and rarefy . . ."—(Codex Atlanticus, f. 161 r.a. 1505).

[7] " That part of air will have more similar motion to the motion of the wing by which it is compressed, which is nearer to that wing. And that will be more motionless which is more remote from that wing. That part of air will be more compressed which is nearer to the wing compressing it. The air of the cold regions will not resist the motions of a bird if it does not embrace a great extent of air below itself."—(Codex Atlanticus, f. 161 r.a. 1505).

In a long successive note of the same year in folio 180 r.a., Leonardo considers the effect of relative velocity between air and wings, as well as between two masses of air. The effect is always the same, *i.e.*, to compress air, so that it acquires the property of resisting with an intensity, which is in proportion to the velocity of the stroke. Air moving rapidly through air, says Leonardo, acquires in virtue of its condensation, so to speak, a weight with which it strikes the objects opposed to it.

The note continues, stating again the identity of flapping and soaring flight, by means of the principle of aerodynamical reciprocity, after which Leonardo examines the three cases occurring in soaring flight, where the bird has to ascend, or to maintain a level path, or to descend, according to the proportion of its weight to the intensity of the wind.[8]

Before leaving Codex Atlanticus, in a folio of the same Codex, belonging to some fifteen years before, that is, before 1490, there is a passage in which Leonardo utilises the reciprocity principle to show the dynamical identity between the flapping flight of an eagle, which beating its wings, even at a very great height, where air is more rarefied, is able to keep up, and the sailing of a ship under the force of the wind. From both these facts, identical in principle, Leonardo deduced the possibility of solving the problem of mechanical flight by means of suitable wings acting on the air.[9]

General Principles of Leonardo's Aerial Machines

Before 1490 Leonardo conceived the three types of machines known to-day as the ornithopter, the parachute and the helicopter, in which lift is obtained dynamically, acting on air by means of suitably shaped parts, which in the case of the ornithopter are wings, in that of the parachute are the surface of a tent roof, and in that of the helicopter are a helical surface.

Here is not the place to enter into a discussion of Leonardo's ornithopters which I have treated of in detail elsewhere ("Leonardo da Vinci and Mechanical Flight," *l'Aerotecnica*, August, 1927, issue), showing the evolution of his ideas, between 1490 and 1505, through which he passed from the pure flapping wing machine of his first period to the more or less soaring one of his last years. In that article I quoted, indeed, some passages belonging to the Codex on the Flight of Birds (1505), in which considerations are found on the saving of energy

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[8] "Air moves through air and moving compresses and its compression is in proportion to its velocity. And compressing it acquires heaviness and its stroke on its object is in proportion to its heaviness.
As it is to move the object against the motionless air so it is to move the air against the motionless object. Therefore the bird beating its heavy wings on the thin air causes it to compress and resist. And if air moves against motionless wings the same air supports the heaviness of the bird through air.
When the power of the motion of the air will be equal to the power of the descent of the bird, the same bird will keep up on the air motionless. And if the motion of the air will be more powerful, it will compress and will raise the bird up, and if the power, of the motion of the air will be less than the weight of the bird . . . [the note is here broken off]. . . . Air outside of its sphere has weight in itself. Air does not resist if it does not compress. Air does not compress if it is not moved. Air compresses when it moves within air by which it is stricken."—(Codex Atlanticus, f. 180 r.a. 1505).

[9] "The same force as is made by the thing against air, is made by air against the thing. You see that the wings striking against the air cause the heavy eagle to keep up in the very high air, close to the sphere of the element of fire. [The ancients divided the world into four zones of decreasing density: earth, water, air, and fire].
Again you may see the moved air over the sea, which striking on the swelling sails, causes the loaded and heavy ship to go; therefore by these reasons, both demonstrated and quoted, you will know that the man with his connected and great wings, making force against the resistant air and conquering it, will succeed in subjugating it and rising above it."—(Codex Atlanticus, f. 281 v.a. 1486-90).

on account of the help of the wing in soaring flight, which therefore appears as the most suitable also for man.[10]

But another important passage on this matter is to be found in Codex Atlanticus, at folio 161 r.a. (1505), contemporary to that of the Codex on the Flight of Birds. This passage I did not then take into consideration, having limited my researches to the oldest part only of Codex Atlanticus, which is contemporary to the Codex B (1486-90).

In this new passage Leonardo intended to show that his mechanical bird is a machine able to reproduce the natural bird, but within certain limits. In fact with his machine man will be able, indeed, to reproduce all the movements of flying creatures; but the movements transmitted by a man to the parts of his machine cannot be so powerful as those effected by the organs of birds to propel themselves through their own efforts. On the contrary, the flying machine will be able to imitate fully the movements of birds in assuring balance and stability.

The distinction established here, between the actions of balance and force, limiting human possibilities to those of balance only, is certainly the idea which led Leonardo in the year 1505 to renounce, more or less completely, the idea of propelling his machine by means of human muscular energy, which he considered too weak in comparison with that of birds, and to entrust the machine propulsion to the wind, and its balance and stability to the man in which he was able to imitate birds.

Evidently, he adds in this note, there will be among the various balance movements of birds, certain movements so imperceptible, that man will not be able to perceive and reproduce them, but to prevent the fall of his machine and to balance it, it will be sufficient for him to imitate the more perceptible ones of birds.[11]

Passing now from the ornithopter to the other air machines conceived by Leonardo, it can be said that on the parachute and the helicopter there are two notes only in his manuscripts, one for each of them, and those indeed in his earliest writings. The note referring to the parachute is found in the folio 381 v.a. of Codex Atlanticus (1486-90), already mentioned. The helicopter is not described in Codex Atlanticus, but in the Codex B, written in the same period (1486-90), containing the first flying machine projects designed by Leonardo.

The helicopter is another application of his fundamental idea of lift by the compression of air under proper velocity pressure. Air stricken by a helicoidal surface, he says, rapidly rotating through it, compresses, allowing the instrument to screw in, or, as he quaintly said, " to make its female in the air."

Other Statements of the Air Condensation Theory and of the Aerodynamical Reciprocity Principle

In other writings of Leonardo, besides those already considered, there is a

10 " . . . it needs little force to sustain itself and to balance on its own wings and to direct them on the path of the winds and to govern its own course, and a little movement of the wings is sufficient, and a much more slow movement as the bird is larger."—(Codex on the Flight of Birds, f. 17 (16) r. 1505).

11 " The bird [the artificial bird] is an instrument working according to mathematical law, an instrument which it is within the power of man to make with all its motions, though not with such a power [that of the natural bird]; but its power only extends to the faculty of balancing. We may therefore say that such an instrument compounded by man is lacking in nothing but the soul of the bird, and this soul must be replaced by the soul of the man.

The soul in the members of birds will without doubt better conform to their needs, than that of the man which is separated from them, and especially in the almost imperceptible motions of balance. But because we see that the bird provides for the more perceptible varieties of motions, we are able through this experience to understand that the more perceptible ones could be known to the intelligence of the man, and that he will to a great extent be able to provide against the fall of that instrument of which he has made himself soul and guide."—(Codex Atlanticus, f. 161 r.a. 1505).

number of considerations on these two subjects; but new developments of ideas do not appear in them, so that they in general represent only repetitions, almost with the same words, of what has been already said.

Certainly the repetitions which there are in Leonardo's manuscripts on his air compression theory, as well as on his aerodynamical reciprocity principle, show the great importance attached by him to them; but it is necessary also to keep in mind, that his writings consisted in occasional and scattered notes, put down at various times, on various subjects, and without any connection with one another; so that repetitions were unavoidable in them, as Leonardo himself wrote in a note prefixed to that part of the Arundel Codex written in 1508.[12]

So that a repetition of the aerodynamical reciprocity principle is found in the same Arundel Codex, in folio 163 V.[13]

Similarly, in the " Codex on the Flight of Birds " (1505), he stated again the velocity conditions necessary to give rise to lift,[14] while in his last manuscript, Codex E, 1513-15, the reciprocity principle is enunciated again, to be applied to a question of gliding flight, which is that if a bird, while gliding, wishes to prolong its path before landing, it strikes the air with its wings, with the result that this stroke, on account of the said principle, will have the same effect as a gust of wind, which, striking the bird under its wings, will raise it up.[15]

Finally, in the same Codex E, we meet another time the statement of the fundamental property of the air of being compressible and rarefiable without limits, to infinity.[16]

The Wing of Birds as the Organ of both Propulsion and Lift

Beating of wings is not essential to flight (this, as we have said, was the great conquest of Leonardo), as wind also is able to provide for progression and lift; but, of course, on condition that there is wind. While if there is no wind, the bird has to provide for progression and lift by itself, by means of its muscular efforts.

The problem now is to understand how the wing of birds, which in soaring flight is the simple organ of lift and its work consists only in balancing the creature, becomes able in flapping flight to carry out the work of propelling. The question is treated of by Leonardo in the Codex on the Flight of Birds

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12 " This is a collection without order drawn from several papers which I have copied here, hoping to be able afterwards to put them in order to their own places, according to the matter with which they deal; and I think that before I have accomplished it I am to repeat the same thing many times. Therefore my reader do you not blame me as things are very many and memory cannot hold all, and say that it is not to be written as I wrote it before. And not to fall in this mistake it would be necessary, in each case that I have to copy something and not repeat it, that I would have to read all the past, and specially as long intervals of time pass between writing from one time to another."—(Arundel Codex, Introduction, 1508).

13 " Because as much it is to move the air against the bird in itself motionless, so much to move the bird against the air in repose. Therefore we will say on account of the first . . ."—(Arundel Codex, f. 163 v. 1508).

14 " When wings are swifter to compress air, the air to escape from below wings, the air compresses and resists the motion of the wings; and the mover of the same wings [the bird] overcoming the resistance of air, arises in contrary motion to the motion of the wings."—(Codex on the Flight of Birds, f. 11 (10) r. 1505).

15 " As it is to move the air against the motionless thing, so it is to move the thing against the motionless air.
When the bird moves with a slow descent and in a long path without beating of wings and that its declination leads it sooner towards the earth than is its intention, then it lowers the wings and moves them against the motionless air, and such a movement raises up the bird, not otherwise than if a wind wave strikes it below."—(Codex E, f. 38 r. 1513-15).

16 " Air in itself is compressible and rarefiable to infinity."—(Idem, f. 47 v.).

as follows:—The bird, Leonardo says, provides for both functions of supporting and propelling, respectively, by means of two different parts of its wing. In the first phase of its manœuvre the distal part of the wing, *i.e.*, its extremity, anatomically representing the hand of the creature, strikes with its beating the air, compressing it. The result is that, owing to the resistance of the compressed air, the bird is driven in a contrary motion to that of the wings. In the meantime the other part of the wing, the basal one, corresponding to the elbow of the creature, is put by the latter so as to cut the air, in order to reduce the drag. Then a second phase takes place, in which the bird raises its extremity, or hand, to prepare it for another stroke; this time it is the basal part of the wing, the elbow of the creature, which operates, and its operation consists in disposing itself at the proper angle of attack on the air, with the result that, on account of its velocity, the wing is supported by the compressed air, above which it glides as on a solid inclined plane, without any lowering of the flight path.[17] This double function of the wings, effected by means of their two parts, is repeated by Leonardo in Codex K (1505-09), saying that the tip of the wing propels, while the remaining part of it supports the bird.[18]

The Problem of Drag in Leonardo's Manuscripts from 1492 to 1505-6

The Philosophical Theories on Continuation of Motion in Leonardo's Time

The first writings of Leonardo on the resistance of air on bodies moving through it, are essentially characterised by this fact, that they, instead of dealing with an effective resistance to the motion deal rather with certain air actions quite favourable to it, saying that any resistance met by those bodies was overcome by a contrary impulse to the motion given by the air itself, except perhaps in its very beginning, when this supposed impulse of air not yet being fully developed, air drag was still capable of exerting its retardative function.

To understand whence Leonardo drew this strange idea of actions of air assisting motion, it is necessary to consider the quite different point of view of a student of mechanical phenomena before and after the discovery of the law of inertia.

In fact, after this the question is to know why a body put in motion, after more or less time, stops; that is to find the causes retarding motion; while before, the question was to know why a body, put once in motion, was capable of continuing the motion for more or less time by itself; that is, to find the causes maintaining motion.

These latter causes were to the ancient philosophers furnished by two theories; the first theory coming from Aristotle (IV Century B.C.) explained the

[17] "The hand of the wing is that which causes the impetus, and then its elbow puts itself with the edge forward not to hinder the motion caused by the impetus, and when the same impetus is afterwards actually created, the elbow lowers and makes itself oblique, and oblique becomes the air, where the latter puts itself as in form of a wedge, on which the wing raises itself up; and if the motion of the bird were not so performed during the time that the wing goes forward again, it would sink towards the end of the impetus; but it is not able to sink, because as much as the impetus lacks, so much the percussion of such an elbow resists this descent and raises the bird up."—(Codex on the Flight of Birds, f. 15 (14) v. 1505).

"Always in raising the hand the elbow is lowered and compresses the air and in the lowering of this hand the elbow is raised and remains edgewise, lest it hinder the motion through the air that strikes thereunder.

The lowering of the elbow at the time when the bird sends again the wings forwards edgewise a little on the wind, led by the impetus already acquired, causes the wind to strike under this elbow and form an edge on which the bird with the said impetus, without beating of its wings, mounts up; and if the bird is 3lbs., and the breast $\frac{1}{4}$ the width of the wings, the wing will feel but $\frac{2}{3}$ of the weight of such a bird."—(Idem f. 18 (17) r.).

[18] "In beating the wings to keep up and to go forward: from the hand upwards causes to keep up, and the hand causes it to go forward."—(Codex K, f. 9 r. 1505-09).

continuation of the motion of a body, after having ceased contact with motive agency (for instance the motion of an arrow in the air after having left the bow) by admitting the body to be supported by the air, urging it from behind to fill the vacuum which otherwise would be formed and which, it was said, " nature abhors."

This so-called " medium theory," for making the medium (in this case the air) responsible for the continuation of motion, was opposed by a second theory coming from Philoponus (VI Century A.D.) known as the " impetus theory," meaning by impetus an energy transmitted by the motive agency to the body, which thus became able to continue by itself the motion until, the impetus having been all expended, it came finally to rest. Leonardo accepted the impetus theory to explain the continuation of motion but, like other authors of his time, did not, at first, renounce completely the former one, thus admitting that the impetus actually moved a body through the air, but the latter contributed to prolong still more its motion.

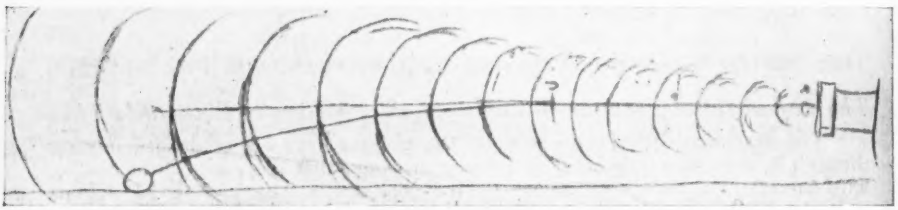

FIG. 1.
Air wave formation before a cannon ball and form of the projectile's path, according to ancient ballistics.

To understand still better the formation of such opinions let us remember what a thorny problem finding the cause of the acceleration of gravity has been for many centuries. It is known, for instance, that Galileo, though he had discovered the law regulating the fall of bodies, did not understand the cause of their acceleration which he in the third day of his " Discourses and Mathematical Demonstrations " (1638), considered a useless investigation.

In fact the ancients, with their concept of force as a cause of velocity and not like ours as a cause of the variation of the latter, were compelled to explain the cause of the acceleration of gravity, by attributing it either to a continuous internal increment of weight, for various reasons, according to various authors, or to external circumstances and these were attributed to the air. All this explains enough the origin of such admissions on the assisting action of air on falling bodies, by assuming that air accelerated their motion either by means of an impulse from behind, or, as we will see, of a wave formation from before. And as accelerated motion was extended (quite arbitrarily indeed) by ancient students from falling bodies also to thrown ones, that is, to projectiles, it followed that at Leonardo's time a great number of opinions were in circulation about these motive actions of air on bodies moving through it, of which the echo, of course, is found also in his manuscripts.

Action of Air Accelerating Motion of Projectiles, According to a Note of Leonardo in 1492

The first note of Leonardo on the motive action of air occurs in the folio 43 v. of the Codex A (1492) in which a long discussion is dedicated to a pretended formation of air waves before a cannon ball, with the result of accelerating its velocity in the first part of its path.

It was, in fact, the usual admission of the ballistics of that time that in the middle of its path the velocity of a projectile was a maximum and until this point rectilinear, while after the middle the velocity would begin to diminish and the path direction to incline. Now to explain this pretended acceleration Leonardo, according to others of his contemporaries, said that a bullet meets at first a great resistance from the air, which being at rest has to be opened and driven away, and therefore the bullet cannot develop full velocity on account of its impetus. But after a little time the air, having been put in motion, and its undulatory motion being formed, its resistance diminishes and the body speed reaches a maximum, after which, as the impetus gradually diminishes, the speed of the body also diminishes, until, the impetus being all expended, the body ceases its advance and falls on account of the gravity.[19]

Actions of Air Accelerating Motion of Gravity According to Leonardo's Writings up to about 1500

Successive writings of Leonardo show the use made by him of that undulatory motion of air and also to explain the acceleration of gravity. But as acceleration of gravity did not occur if bodies were falling through water, he did not admit any formation of waves below them in the latter. In fact in a note at the folio 10 v. of the Arundel Codex, the formation of waves below falling bodies to accelerate their motion is asserted for air and excluded for water.

This folio 10 v. of the Arundel Codex was written by Leonardo in the year 1508, but notwithstanding this fact the note must belong to an earlier period of Leonardo's life.[20] In fact it must be remembered that in this part of the Arundel Codex, as Leonardo himself wrote in his foreword to it, several notes were drawn from previous notebooks. Now among these notes belonging to an earlier train of thought of Leonardo and re-written without change in 1508, there

[19] "The straight course made by heavy bodies which with violent motion pass through air will be more powerful, and of a stronger percussion against impediments opposed to them, in its middle part than in any other of the same.

The reason of it is that when a heavy body starts from its strong mover, though this start is in the first degree of its power, nevertheless as it meets air without motion, it meets it in first degree of its resistance; and though the same air presents an amount of resistance greater than the power of the heavy body pushed against it, nevertheless as the body strikes a small part of air, the former remains victorious; therefore it drives it away from its space and in driving it away it diminishes a little its own velocity. Thus being this air pushed, it pushes and drives away other air and generates behind itself circular movements, of which the body moved in it is always the centre, like as the circles made in water which have their centre in the place stricken by the stone. And so each circle driving away the other which is before its mover, all is prepared along this line to movement, which so increases as the body pushing it approaches; therefore the same body, meeting less resistance of the air, increases its course with greater velocity, like as a boat pulled through the water, which in its first motion moves with difficulty, though its mover is at his greater strength, and when the same water with arched waves begins to assume motion, the boat following this motion meets little resistance, therefore it moves with more facility. Thus similarly the bullet (Fig. 1) meeting little resistance continues the motion started as long as it, something left of its original force, begins to weaken and to decline, therefore, changing its course it is no more assisted by the flight which has been prepared for it by the flying air; and in proportion as it declines it meets various resistances of air and it is slowing down, until it takes again its natural motion and it becomes again more velocious (also the boat by turning slows its motion).

Now I conclude, on account of the eighth proposition, that part of motion which is between the first resistance of the air and the beginning of its declination is more powerful and that is the middle of the course, which is made through air with straight and direct line."—(Codex A, f. 43 v. 1492).

[20] "The heavy body which descends through water always maintains the same speed (Fig. 2). This which has been stated occurs, as water does not open the way for the mobile as does air and cannot make undulating motion as air downwards. Therefore it is necessary for a mobile penetrating a medium of equal resistance that the motion of the mobile is of equal speed."—(Arundel Codex, f. 10 v.).

is certainly this passage, in which such an idea is set forth which was modified by him about 1505-6, at which time he admitted that an undulating motion must occur before falling bodies only in water, excluding it for the air.

More extensive considerations on this undulating motion in air are found in Codex M (1497-1500), which contains three notes about the accelerating action of air on bodies falling through it. In the first Leonardo deals with the question why two weights, if falling tied together with a string two feet long, after a certain time will come in contact. The cause is, he answered, that the body below, meeting more dense air than the body above and having to open the air and put it in an undulatory motion, had to overcome greater resistance and therefore could not develop such a velocity as the weight above.

FIG. 2.

No formation of waves below a falling body in water, according to an early idea of Leonardo.

In the same note; examining the general movement of air around the two bodies, he said that a part of the air below runs away above, whirling and striking with eddies the second body, while the superior air runs in to fill the vacuum behind it.[21]

The two successive notes belong to the folios 45 v. and 46 r. of the same Codex, in which this undulatory motion is explained in more detail.

In folio 45 v. he says that, owing to the great mobility of the air, a wave is produced by a body falling in it, which wave produces another wave, and this another, and so on, so that the air for a great extent downwards assumes an undulatory motion which, preceding the body, being of greater velocity than it, prepares the way for the same.[22]

In the other passage, he says that this formation of waves is made apparent by analogous phenomena in water, so that the fact is that a body falling in air

[21] "If two equal bodies are situated one below the other perpendicularly, and at the same time left to fall, they in a long descent will consume their interval and will come to touch each other.
When the air is without fog or clouds you will find that in each degree of its height it acquires degrees of subtlety. And so conversely in each degree of lowness it acquires degrees of density, therefore if two equal bodies, situated one below the other for the space of a cubit, *i.e.*, tied with a thread and left together to fall, they after a long motion will touch each other, because that below always is in thicker air than that above, and, besides this, the former has the labour of opening the air and of creating the undulatory motion of the air, which partially runs away above and jousts and strikes with eddying motions against the second body; while the other superior air runs in to fill the vacuum which remains behind such a body."—(Codex M, f. 43 v. 1496-1500).

[22] "The wave of air which is generated by a body which moves through the same air will be much more velocious than the body by which it is driven.
What is above proposed occurs, because being the body of the air very quick and easy to the motion, when a body moves through it, the former comes to make the first wave on its first motion and at the same time that wave cannot be generated without causing another behind itself and that another. And so such a body moving through the air in each degree of time makes multiplications of waves below itself, which through their flight prepare their way of the motion for the movement of their mover. The wave of the air being successively created prepares the way of the motion for its mover."—(Codex M, f. 45 v. 1496-1500).

is pushed from above and pulled from below, the latter assisting the former action. From this Leonardo concludes that the air below a falling body cannot resist it and does not present any impediment to the same, so coming to exclude, at least in the case of falling bodies, any effect of drag in air.[23]

FIG. 3.
Air wave formation below a falling body, according to Leonardo's ideas about 1500.

Comportment of Air Towards Bodies Moving Through it in Comparison with Water, According to Leonardo's Ideas about 1505—1506

About 1505-06, as is shown by a note in folio 168 v.a. of Codex Atlanticus, Leonardo began to modify his ideas on the behaviour of the fluid towards bodies moving through it, stating that an undulating motion before bodies preparing the way for them ought to take place solely in water, and excluding it in air; quite the contrary point of view to that previously admitted. Rather, he stated, that instead of this undulating motion as in water, a condensation before bodies had to occur in air according to its basic property of being condensed under a proper velocity pressure.

Certainly compression of air resists bodies moving through it, but this resistance cannot at last impede their advance, as the push of air on bodies in motion, while running in behind them, to prevent a vacuum, is much stronger than the resistance due to its compression, with the result that the motion of the body is actually assisted by air.

In short, the cause of the motion of bodies for Leonardo about 1505-1506 consisted essentially, as he admitted according to the most modern physics of his time, is *an impression transmitted by the mover into the mobile*, that is in the so-called *force* or *impetus;* but the effect of the latter was prolonged and assisted, as he similarly admitted yielding to the traditional physics of the school, by motive actions of air and water.

But in water, Leonardo at last observed, owing to the wave formation and its more powerful push behind bodies in motion, on account of its greater weight, the motive assistance of the fluid is much more important than in air. From

[23] "The heavy body which free descends, in each degree of motion acquires a degree of weight. This takes rise from the 2nd of the first [allusion to a treatise on mechanics] which says: that body will be heavier which meets less resistance.
In this case of the free descent of heavy bodies one sees apparently, by means of the experience already quoted of the waves of the water, that the same wave is made by the air below the thing which descends, because it is pushed and from the opposite part pulled, that is that the air makes a whirling wave which assists in pushing downwards (Fig. 3). Now for such reasons the air which flies before the body which put it away, shows apparently that it does not resist the latter and consequently does not impede such a motion; thus in proportion as the wave descends, which moves quicker than the heavy body moving it, so the motion of the heavy body lasts, so the last wave moves itself more far from it and prepares an easier flight for the air which touches the heavy body."—(Codex M, f. 46 r. 1496-1500).

which he derived the final conclusion that fish are more assisted in their motions by water than birds in theirs by air, and that in consequence the velocity of fish had to be greater than that of birds.[24]

Before closing this first period of Leonardo's researches on the behaviour of air towards bodies in motion, a last passage is to be quoted, in which use is made, in a certain way, of a proceeding usual to-day in extending considerations of fluid conditions to infinity.

When a body, says Leonardo, leaves its space, suddenly an equal volume of air immediately successive to it, will occupy its space, to prevent a vacuum; for the same reason, the space left by this mass of air will be occupied by another equal volume of air immediately successive to it, and so on, so that the displacement would theoretically extend to infinity. But practically it will not continue to such an extent, owing to the compressibility without limit of air.[25]

Summing up from Leonardo's writings on the resistance of air during this first period, which extends from 1492 to 1505-06, we can say that until about 1500 he admitted that bodies in motion through air were assisted by it, both on account of an undulating motion before and of a pushing action behind, on the part of the air in such a manner that any resistance or drag of air must be quite nullified.

Later, at the very end of this period, about 1505-06, Leonardo began to limit the action of air assisting motion, by excluding in it any formation of waves before bodies in motion, but continued to admit a pushing action of air behind them, so that, at any rate, motion of bodies through air was always assisted, and therefore drag was always overcome.

It yet remained to Leonardo to take a second step, that of abandoning also the assumption of the pushing action of air from behind, thus excluding any action contrary to the development of the resistance of air, and recognising it to its full extent.

This final step he actually did in the successive period, liberating himself completely from the influence of his time's philosophy, and therefore attacking the problem of the behaviour of air and water toward bodies in motion from a point of view founded only on the experience and the evidence of the senses.

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[24] "The impetus at every degree of time acquires a degree of diminution and the prolongation of its essence issues from the air or the water, which shuts behind the mobile in filling the vacuum which has been left by the mobile which penetrates it; which air is more powerful to strike and to urge with its strokes behind the mobile than is the antecedent air to resist through compression the penetration of the mobile, and such a compression is it that diminishes the strength of the said mobile. . . .
. . . Water in itself is more dense than air and consequently heavier, therefore it makes itself more velocious to fill the vacuum which of itself is left by the fish in the place from which it swims away, and also the water which is stricken by it before itself, does not compress like as the air before the bird; on the contrary it makes an undulating motion which with its motion prepares and increases the motion of the fish; therefore it becomes more velocious than that of the bird, before which the air compresses itself.
The impetus is an impression transmuted by the mover into the mobile and maintained by the air or the water while moving to prevent the vacuum.
The impetus of the mobile through water is different from the impetus of the mobile through air, and such differences result from the varieties of the aforesaid liquid, as the air is compressible to infinity and water not."—(Codex Atlanticus, f. 168 v.b. 1505-06).

[25] "The impetus is a virtue transmuted by the mover into the mobile and maintained by the wave which by such a mover is generated from the air through the air, and this issues from the vacuum which against the natural law would be generated if the subsequent [Leonardo in this passage wrote always precedent, obviously by mistake] air did not fill the vacuum empty of air, which was expelled from the space by the foresaid mover; and such a subsequent air would not leave [Leonardo wrote fill] its space from which it separated itself, if another quantity of air did not fill the space from which it separated itself; and so it is necessary that it successively continues; and in this way it would continue to infinity, if the air were not compressible to infinity."—(Codex Atlanticus, f. 219 v.a. 1505-06).

The Problem of Drag in Leonardo's Manuscripts from 1506—1515

Actions of Air Assisting Motion No Longer Admitted by Leonardo

The Leicester Codex (1505-08) immediately following the manuscripts now examined, shows the definitive and final alteration in Leonardo's ideas about the action of air on bodies moving through it. A long paragraph in folio 29 v. of this manuscript is in fact dedicated to prove that air does not push a body, after the latter has been separated from its motive agency.[26]

The discussion is carried out upholding the "impetus theory" against the "medium theory," which indeed had already been done by Leonardo in his previous manuscripts. But the difference between these considerations and those of no more than one or two years before consists in the fact that formerly, though having deprived air and water of their primary function in maintaining motion, nevertheless a secondary part in assisting "impetus" was left by him to them, resulting in a theory which represented but a compromise between Aristotle's medium theory and the impetus one; while now this compromise is abandoned

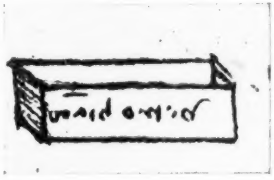

FIG. 4.

Box of glass containing water mixed with rare millet to see movements of the fluid when a body is driven through it. On the box is written from right to left, according to the usual manner of Leonardo, retro bianco, that is, white glass.

and both air and water are quite deprived of any action to assist bodies in action through them.

The arguments with which Leonardo supports in this passage the impetus theory against the medium one have no interest for us, as they are in general the same as used by other authors up to Galileo Galilei. On the contrary the interest for us begins when Leonardo supports his new ideas on the behaviour of air or water around bodies moving through them with experimental considerations.

For instance, in this Codex the following note is very impressive on the discussion in which, anticipating in a certain way some modern methods of making visible, with appropriate substances, hydrodynamical phenomena, he suggests to experiment by mixing water, contained in a parallelopipedal box of glass, with a proper substance, to make visible its movements, and then to drive a body through the same.[27]

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[26] "It is to prove how the air does not push the mobile after that it has been separated from the power of its mover. . . ."—(Leicester Codex, f. 29 v. about 1507).

[27] "If you wish to see what motion is made by air which is penetrated by a mobile, do you take the example from the water, *i.e.*, under its surface, which is mixed with rare millet or other slight seed, which keeps up in each degree of height of water, and then do you drive inside it a mobile which keeps up in the water and you will see the revolutions of such water, which has to be in a square vase of glass in the form of a box." (Fig 4).—(Leicester Codex, f. 29 v. about 1507).

Air Compresses Before Bodies in Motion and Rarefies Behind

A discussion follows saying that the body drives the air and not conversely, and that the former compresses air before itself while it rarefies air behind; which compression is successively destroyed by that rarefaction. But (he adds) it is not to be believed that in such an operation the body can be pushed forward by the rarefied air behind itself, because there is more momentum in the condensed air before it than in the rarefied air behind.

Therefore the body is not assisted in its motion through air by any kind of undulatory motion; neither pulled by waves which could arise before it on account of its pressure on the air, nor pushed by waves produced behind itself by the air running in to restore the normal density of air; because these waves behind have less velocity than the body and thus without any accelerative action on it.[28]

FIG. 5.
Air compresses before a body in motion and rarefies behind.

Formation of Eddies

In Codex F (1508) there are three notes on the same subject, two referring to bodies driven through air by "impetus" and one to falling bodies. In the first Leonardo compares the motion of the air before and behind a body penetrating it and finds that the speed of the air before the body is less great than that of the air behind it.

In fact (he says) the air which is urged by the body does not assume a speed greater than that of the body driving it; while the air running in behind it to fill the vacuum is animated, on account of this, by a greater speed. But it is

[28] "Every natural act is made by the actual on the actuated in the shortest time possible; and the air stricken and condensed by a mobile, by which it is driven cannot be that air which fills the vacuum created by the mobile, which flies forwards; but this vacuum is filled by that air which is nearer to the mobile on its opposite part, *i.e.*, the part whence it flies away, which air continually rarefies that compression and with this operation the said vacuum is filled (Fig. 5).

Never at the same time a greater power can be overcome by a less one; therefore the rapid motion of the rarefied air, to fill the vacuum left by the mobile, is more weaker than that of the air which compresses before the mobile; which compression of air cannot be caused by air more rarefied.

Therefore we have concluded that the mobile is not driven by the wave of air created by the impetus of the mover. And if you are wishing to say that the undulatory motion which flies before the mobile, is that which prepares the motion for it, together with the air flying behind it to restore the normal rarefaction of air, to that it is to be answered that there such an air is undulated by the mobile and not by itself; and it is impossible that in the same time the mover drives its mobile and the mobile its mover; therefore you are wrong, because if the aforesaid undulatory motion is that which pulls behind itself the cause of its motion, it is impossible that one thing by itself alone could be cause of its creation: and those which are by themselves are eternal."—(Leicester Codex, f. 29 v. about 1507).

not to be believed that this air, notwithstanding its great energy of motion, is able to push forward the body, as its speed is not in a straight line, on the direction of the body, but on the contrary, behind the body, air is in whirling motions in form of eddies.

Concluding, Leonardo says that the waves produced by a body on the air before it scarcely pass the body, while the air behind it and following it, striking against the surrounding air in repose, is constrained to go back and to form eddies, on account of which at last it stops, without following the body.[29]

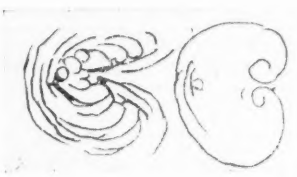

FIG. 6.
Circulation of air around a body in motion.

FIG. 7.
Whirling movements of air behind a body in motion.

In the second note Leonardo observes that air follows for a very little time a body in motion, as is proved by casting a stone along a solar beam penetrating through a window in a dark room, where it will be seen that all corpuscles are whirling around the space successively left in its flight by the stone without following it. In some lines afterwards he adds that the air running in behind the body is in its various parts of various speed and density and motion.[30]

Air Density Distribution and Movements of Air Around Falling Bodies

In the third note Leonardo examines if possible that the vacuum behind a falling body is filled by the air below it, arising with curved motion around the same.

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[29] "The motion of the air has to be smaller before the mobile which penetrates it, than it is behind such a mobile.
The air which fills the vacuum left by the mobile which penetrates the same air, has in its entirety the same velocity as that of the mobile; but that part of the same air being revertive (*i.e.*, of whirling motion in form of eddies) is much more velocious than the motion of the aforesaid mobile.
Here it seems that as the mobile has less velocity of air behind than before it, that such air is the cause of the motion of this body; but that, on account of the seventh proposition, cannot be the case.
No one mobile will never be more velocious than the velocity of the power driving it. The wave created by the air before the mobile penetrating it scarcely passes the same mobile, as this would be against the seventh, here penultimate.
The air behind the mobile goes back in these parts in circulation which are contiguous to that air which flees behind the mobile (Fig. 6). That air which flees behind the mobile flying through it, is driven by the impetus given to it by such a mobile; which air with a greatly extended wave, striking against the other air, goes back and diminishing with great circulation in its extremities, at last stops and does not follow the mobile."—(Codex F, f. 74 r. 1508).

[30] "The air which first was behind the hole made by the mobile through the air a little accompanies the same mobile for the eighth.
8th—The air which successively surrounds the mobile which moves through it makes in itself various motions (Fig. 7). This is visible on the atoms which are in a sun beam when through a window it penetrates into a dark room; in which atoms if a stone is cast for the length of such a beam, one sees all the atoms whirling around the space which was filled by air along the way created in the same air by the mobile.
The air which moves to the filling of the vacuum created into it by the mobile has in itself various speeds and densities and motion."—(Codex F, f. 74 v. 1508).

The answer is that such a displacement of air from below to above would make impossible compression of air, which is an indispensable condition for lift. Therefore this hypothesis has to be renounced, and instead it has to be admitted that such a vacuum is filled not by the air below, which condenses on the spot under the falling body pressure, but by the lateral and superior air, which to this end rarefies and extends, while its movement is as follows: the air above descends on the falling body and the air to the side forms vortices laterally to the same.[31]

An Application of Air Condensation Theory to a Special Problem

The fall of heavy bodies, as we have already seen, occupied in Leonardo's considerations as well as in those of all the ancient students a very prominent place, urging them to form the most various hypotheses to explain the various problems in connection with it.

One among these problems which was considered by Leonardo in these last years, was that of understanding why certain bodies of special form, while falling obliquely through air, turn upside down.

The question is at first approached by him in Codex G (1510-1515), but it is more developed in two notes of the successive and his last Codex E (1513-1515).

To the first note in Codex G there are prefixed these three hypotheses: that the air, compressed under the pressure of a body falling obliquely, flees rather at the back part than at the front of it; that in a continuous mass of air compression in one part is balanced by rarefaction in another; that resistance of air is in proportion to its compression.

From these assumptions is deduced the turning upside down of a body, which by an accompanying sketch is shown to have the form of a board. And to boards are in fact dedicated the considerations on the matter which are found in the two successive notes of Codex E.

After having, indeed, prefixed to the first note of Codex E the hypothesis on the proportionality between compression of air and velocity of the body falling through it, Leonardo asks why a board, though being regular in shape and in all its parts homogeneous, if let fall through air obliquely, cannot maintain this situation while falling, but it is compelled to turn upside down continually until it reaches the ground.

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[31] "The air below the mobile becomes dense and that above rare.

The weight descends through air and the same air moves in a contrary motion to fill continually the place left by the same weight and the motion of this air has to be curved, because arising in the shortest line it is prevented by the weight which descends, above it; therefore it is necessary that it curves and then goes back above the same weight to fill the vacuum left by it.

But, if so, the air would not compress under the velocity of the weight; being so, birds would not keep up on the air stricken by them; but here it is necessary to say that air has to compress under its striker and above has to rarefy, in order to fill the vacuum left by that striker.

And as to the air, as it has been proved in the seventh, there is no inconvenience to be compressed and rarefied almost instantaneously (which is not possible in water as long as it maintains its form) it is more easy to the air lateral and superior to the mobile, descending in it, to fill the vacuum left by the same mobile above itself, than to the air below to curve, and in a long and curved line move to the filling of such a vacuum, and also it is impossible, on account of the eighth, which proves that any impetus created in the air drives with itself the same air along that line in which this impetus has been created, like as the wind which as much as drives air so much its impetus moves, as can be seen in dust driven by such winds or in the atoms in the beam of the sun when one blows among them.

Therefore the air pushed by the impetus of the weight which descends through it flees along the line of the motion created by its mover, and the lateral air converts itself into lateral eddies and the superior one always descends above, always filling the vacuum left above itself by such a mobile in each degree of its movement."—(Codex F, f. 87 r. and 87 v. 1508).

And the answer is that it happens on account of the different compressions, and therefore of the different resistances of air at the two extremities of the board. In fact, while the board falls in an oblique situation, its front edge urging directly the air will compress it, while, on the contrary, at the back of the board air rarefies, with the result that the resistance met by the former is greater than that met by the latter, which means that the front of the board is more supported than its opposite extremity. It happens therefore as if the back edge of the board becomes heavier than its front one.

The board must consequently turn upside down, *i.e.*, the extremity which was in front goes back and *vice versa*. But then the previous conditions are reproduced again, and the board for the same reason must turn up again, and so on.

Asking then for the cause of compression of air, Leonardo repeats here his usual explanation, that is because air cannot transmit the received pressure in a part of itself to all its mass. By way of comparison he quotes the formation of waves before the bow of a ship, on account of the localisation of the pressure to the immediate layers of water.[32]

Further Considerations and Experiments to Exclude Actions on Air Assisting Motion

There is in Codex G (1510-15) a note in which a discussion with an imaginary opponent is related, who upheld that a body moving through air is driven by that part of the fluid surrounding it from the middle backward. But this, Leonardo says, is not at all possible on account of the fact that the air behind the body is pulled by it, while the air compressed before it flees backwards oppositely to the former. So that these two masses of air, being animated by opposite move-

[32] "The air which compresses below the mobile descending in an oblique situation through it, flies rather at the upper part of the mobile than at the lower part of it.
A continuous quantity of air in proportion as rarefies at one part it compresses in another. The less the rarefied air resists, the more the compressed air makes itself more resistant. Therefore the hindmost part of the mobile b will descend with greater impetus than its foremost part, and this is the cause that the front which first was low at the end of the reflected motion rises up (Fig. 8).—(Codex G, f. 73 v. 1510-15).
On the things which descend through the air (Fig. 9). Air compresses before bodies which with velocity penetrate it, with a density which is more or less, according as the velocity is of more or less violence.
The board of a uniform width, length, depth and weight will not maintain at a great extent its oblique motion begun through air, which is penetrated by it, but it will turn back and then forwards, and thus with an undulating motion it will end its descent. And this happens as air alters its uniform natural density, because it compresses under the right angle of the front of the board, which front strikes and opens the air. But at the opposite extremity of the said board it [the air] does the contrary with its rarefaction, and because that rarefied air is less resistant, the back [Leonardo wrote front, evidently by mistake] of the board appears heavier.
The rarity acquired by the air behind the said board is more important than the density which is generated on the front of this board.
The explanation why air compresses is this: air compresses before bodies by which it is penetrated, because that which pushes a part of the air does not push all that is before it. And this is understood by the undulation which is generated before the bow of a ship.—(Codex E, f. 70 v. 1513-1515).
The air becomes rarer behind the motion of the mobile in proportion as it becomes denser before the same mobile.
The exactness of an oblique descent will not be continued by falling bodies of uniform greatness and weight in air of equal resistance. And this is caused by air compressed by the front of the body penetrating it, which by compressing resists and stops this front, therefore the opposite extremity of such a beam, as it is in rarefied air, immediately acquires heaviness and falls with more velocity than that which is delayed by the thickness of the air compressed by it.
And therefore the impetus made by the mobile towards the right angle turns to the left, maintaining this obliquity until other air compresses again below it, which air again resists it and the oblique descent to the left again turns to the right, and then from right to left, and from left to right, until the motion is ended, etc."—(Codex E, f. 73 r. 1513-1515).

ments, will strike each other, with the result that they are compelled to rebound, from which eddies issue, which will be carried away by the air running in to fill the vacuum.[33]

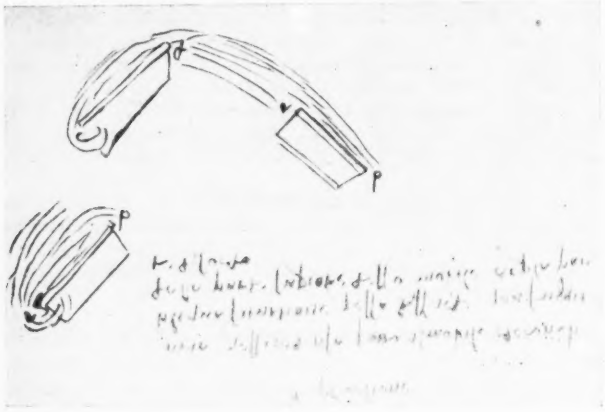

FIG. 8.
Turning upside down of a falling board owing to the condensation of air on its front edge and rarefaction of the same on its back one.

FIG. 9.
Path of a falling board.

[33] "And if it will be said by the adversary that the impetus driving the mobile is in that air which surrounds it from its middle backwards, this has to be denied, as the air which follows the mobile is pulled by it to fill the vacuum left by it; while that air which compresses before the mobile flees in an opposite course.
And if air goes back is apparent that it will strike against that which is pulled behind itself by the mobile, and when two things shock, rebounding motion of both arises, which are transmuted into whirling motions in opposition one another, which are conveyed by the air, filling the vacuum left by the mobile. And it is impossible that the motion of the mover could be increased at the same time by the motion of the mobile, as the motion of the mover is always more powerful than that of the mobile."—(Codex G, f. 85 v. 1510-1515).

The two notes also in Codex E have the same purpose *i.e.*, to show that bodies are neither pushed by air from behind nor pulled by it from before.

In the former note Leonardo repeats that air by shutting behind the bird cannot push it forwards, as this air has the same velocity as the bird. On the contrary, it is the bird which, while opening and driving away the air which is before it, and makes as it were a sheath for it, draws at the same time towards itself the air behind. Leonardo in this passage, as he is dealing with a question many times treated of, does not complete it, but leaves its termination to be understood with an etc.[34]

In the second note Leonardo suggests to observe the configuration of dust behind a running horse, to convince himself that air follows it but a very little time; as the dust very soon turns back with eddies by which its kinetic energy is consumed.[35]

This continual obstinacy of Leonardo in showing always with new arguments that air cannot assist bodies in motion, is not to be wondered at, as in his time the "medium" theory was universally accepted, making it necessary to find always new proofs against it. Even Galileo, more than a century after, had to dedicate one day of his famous "Dialogues on the Maximum systems" (1632) to fight the "medium theory" and its consequences.

The Lay or Proportionality of Drag to Surface and Velocity

In several notes of Leonardo the admission is made that compression of air is directly proportional both to the velocity of stroke and to the resistance which arises from it. From which it followed that air resistance and body velocity are proportional to each other; an assumption admitted also by Galileo.

Another assumption of Leonardo was that the same proportionality exists between the resistance of air and the surface of the body in motion.

Both these assumptions are clearly expressed by Leonardo in a note of the second part of the Arundel Codex, in which by means of them and through a train of thought a little strange and naive to us, he tried to accord his experimental result, that two homogeneous spheres of unequal diameter fall in the same time, with Aristotle's theory, universally accepted at this time, that the speed of fall is proportional to the weight.

His argument to make this agreement between experience and theory was the following:

Let us let fall two homogeneous spheres having respectively diameters of one and two feet. Their surfaces, and according to his first hypothesis (proportionality between surface and resistance) their resistances, will be as one and four, while their weights are as one and eight. Their weight for unity of surface will then be as one and two and consequently, according to Aristotle's hypothesis (proportionality between weight and velocity of fall), the spheres would fall with velocities one and two. But, owing to his second hypothesis (pro-

[34] "As much air runs in behind the vacuum which is left by the bird perforator of the air, so much the bird flees away before the air, which continually is joined through contact with it. Therefore it is not the shutting of the air behind the bird which drives forwards the bird; but it is the impetus which, driving the bird forwards, opens and drives away the air by which it is sheathed, as well as draws to itself the air, etc."—(Codex E, f. 53 r. 1513-1515).

[35] The following note was written by Leonardo on September 25th, 1514, in the Bell Inn at Parma, as he himself indicates in this folio:—

"In the air which envelopes the bodies moves together with such bodies.

The air which envelopes with herself the bodies will move together with them, and this will be shown by the observation of a horse when running in dusty roads.

If the motion of air is as velocious as is its mover.

Air will never be of equal velocity to that of its mover, and this will be shown by the motions of the aforesaid dust following the course of a horse, which in very little length of motion turns back with an eddying motion in which its impetus is consumed."—(Codex E, f. 80 r. 1514).

portionality between resistance and velocity) it follows that also their resistances had to be as one and two. But if velocities of fall are as one and two and the respective resistances as two and one, the two spheres cannot fall with different velocities but with the same, and also compression of air by them produced will be the same.[36]

Distribution of Fluid Densities and Resistances Around Bodies Moving Through Air and Water

Drag in air, according to Leonardo, was due principally to the air compression which increased with velocity of stroke. In water instead, where no compression took place under any pressure whatever, drag was the effect only of the opening and driving away the fluid.

The invariability of densities (and therefore of resistances) in water, around a body moving through it already stated for falling bodies in folio 10 v. of the Arundel Codex, was afterwards expressed by Leonardo in a note of Codex E, also for fish, where, he added, the fluid flows around their bodies closing perfectly behind them; so that as much water as opens before so much shuts behind.[37]

Such an advantage, due to their streamlined form, had been already recognised by Leonardo in the previous Codex G, examining why this form is the more efficient to reduce drag also for ships. This cause, he said, depends on the fact that this form allows the waves, produced by the ship's bow, to press the body of the ship for a great extent of it, which he calculated two-thirds of its length backwards.

The less efficient form instead is that in which bow is sharper than stern, as in it waves close along the ship for a less extent of its length, which he calculated one-third of the same. Finally the form having both its extremities of equal sharpness was considered by him of an average efficiency between the two.[38]

Passing now to the subject of the air density conditions around bodies moving through it, we have already found here and there some general statements on air compression before and air rarefaction behind them. Moreover in the particular case of falling bodies we have found also a complete description of density

[36] " On the resistance of air and balances. That body has less weight which more extends and that air more resists which in the same way more extends, *i.e.*, that interposes between the weight and earth a greater amount of itself. But the proportion of weights is not according to the proportion of air, since if a spherical weight has a diameter of one foot and a similar weight has a diameter of 2 feet, in such a case the air interposed between these weights and the earth will resist the weight of one foot in diameter for one degree and the weight of 2 feet in diameter for 4 degrees.
Therefore passing from one diameter to the other, it happens that the resistance of air is quadruple, while from one weight to the other the proportion is octuple, and therefore being quadruple the proportion of the two resistance, *i.e.*, as one to 4 and the proportion of the weight being ocuple, *i.e.*, as one to 8, the resistance of 8 is twice the resistance of 4, and therefore the motion of the greater weight is of velocity double that of the motion of the less great, being air of the same resistance. But as air doubly compress against the mobile of double velocity the aforesaid motions will be of equal speed. But if motions are equal the air will not doubly compress but it will be equal."—(The Arundel Codex, f. 96 v. 1508).

[37] " What difference is there between properties of water and of air?
Water in itself is neither condensable nor rarefiable, but is the same before the fish penetrating it, as it is behind this fish, and as much water as opens before its penetrator, so much it is which shuts behind such a penetrator."—(Codex E, f. 71 v. 1513-1515).

[38] " On motion of ships (Fig. 10). These 3 ships of equal width, length and depth, if they are driven by equal powers will have motion of different velocity, because the ship which brings forward its wider part is more velocious and it is like to the shape of birds and gray mullet. And such ship opens sideways and before itself a great deal of water, which then with its revolutions presses the ship for two-thirds of its length backwards.
The contrary is done by the ship d c while the ship e f is the average between the aforesaid two."—(Codex G, f. 50 v. 1510-1515).

distribution and of the movements of air around them, in Codex F (folios 87 r. and 87 v.).

But now we will see a note of Codex E in which a complete picture of air densities (*i.e.*, of air resistances) is given around a flying bird.

In fact in this note, Leonardo says that around a flying bird there is thick air before and below, thin air above and behind; thinness above being in proportion to thickness below. Moreover, thickness is more important before than below, as also thinness is more important behind than above, this difference being in both cases in proportion to the velocity of the bird forwards.[39]

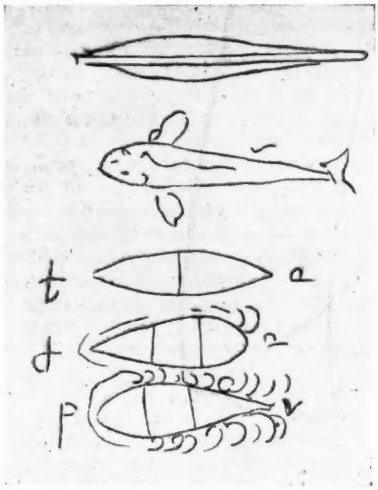

FIG. 10.

Ship forms of various efficiency.
ab The more efficient form.
cd The less efficient form.
ef The average efficiency form.
(The letters are inverted according to the usual manner of Leonardo.)

Let us substitute the terms high air pressure and low air pressure for those of thick air and thin air used by Leonardo, and we will have a picture of the distribution of air pressures around a bird similar to that which is admitted around aerofoils by aerodynamics to-day !

Conclusion

The results of the work of Leonardo da Vinci on aerodynamics can be summarised as follows :—

1. Lift is the effect of relative velocity between air and wings, this velocity, if sufficiently high, producing almost instantaneously a local compression of the

[39] " What quality of air surrounds birds in flying. The air surrounding birds is above thinner than the usual thinness of the other air, as below it is thicker than the same, and it is thinner behind than above in proportion to the velocity of the bird in its motion forwards, in comparison with the motion of its wings towards the ground; and in the same way the thickness of the air is thicker in front of the bird than below, in proportion to the said thinness of the two said airs."—(Codex E, f. 45 v. 1513-15).

air stricken by the pressure of the wings, and thus becoming capable of resisting and supporting them.

2. The degree of velocity sufficient to give rise to this local compression of air is that a layer of air has to be stricken by a wing with a velocity greater than is the velocity with which the pressure can be transmitted from that layer of air to the back layers of air. In these conditions air, not being able to yield to the too rapid pressure, loses its gaseous properties, becoming as a solid body.

3. Other surfaces besides wings, if of suitable form and disposition to the air, are able to give rise to lift. Thus, besides ornithopters, also an aerial screw and a parachute were designed by Leonardo.

4. The existence of relative velocity being a condition for lift, it is perfectly the same whether a flapping wing strikes air in repose, or air in movement strikes a motionless wing; this is the statement of the aerodynamical reciprocity principle!

By means of the said principle flapping and soaring flight are identified by Leonardo, and the solution of human flight appeared possible to him, as man, too weak to propel his machine through his muscular efforts alone, is able instead to guide and balance it, if it is propelled by wind.

5. The wing of birds which, when there is wind, is an organ of lift and balance only, becomes in the absence of it, an organ of propulsion as well. The functions of propulsion and lift are executed by birds respectively with two different parts of it, *i.e.*, the base of the wing supports and the tip propels.

6. Leonardo only succeeded in liberating himself from the influence of the ancient philosophy as regards certain presumed actions of air assisting motion and therefore destroying any resistance or drag, after about fifteen years of meditation and efforts; while the remaining years of his life were expended by him to accumulate proofs against those ideas which had formed the object of his previous investigations.

7. Drag of air depended for Leonardo, essentially on air compression, arising from suitable velocity pressure. And as the compression of air was, according to him, proportional to the velocity of the body striking it, also resistance of air, or drag, resulted proportional to the same velocity.

The other assumption made by Leonardo on drag was that it is proportional to the surface of the body in motion. His law, therefore, consisted in the proportionality of the drag to both surface and velocity.

8. Drag in water consisted only in the work of opening and driving away the fluid, but not at all in any effect of compression whatever, as water did not share the compressibility of air. The most efficient form for ships to reduce this drag was recognised by Leonardo to be that known to-day as the streamline one, where the flow closes behind it perfectly.

9. While around a body in movement through water the fluid density, owing to the lack of compressibility of water, remains in all parts unaltered, around a body in movement through air, instead, the density conditions of the fluid vary widely from one part to the other in the vicinity of the said body.

The law of the variation of air density conditions was studied by Leonardo for the cases both of falling bodies and flying birds, in the same way as the invariability of water density conditions had been also stated by him both for the cases of falling bodies and of fish.

10. The law of the distribution of air density around both falling bodies and flying birds was, according to Leonardo, as follows:—

In falling bodies air is compressed below and it is pushed downwards, while it rarefies to the side and above, descending on the falling bodies; all these air movements, however, lasting only a very short time.

Around flying birds air compresses before and below, rarefies above and behind; compression before is more important than below and rarefaction behind more important than above; all this being in proportion to the velocity of the bird forwards.

SUMMARY OF THE SOCIETY'S ACTIVITIES

DECEMBER 1929—DECEMBER 1930

The following places on permanent record in the Journal the notices which have appeared in the Monthly Notices inset in the Journal, and so summarises the Activities of the Society for the year.

President

The Council at their meeting on 24th June, 1930, unanimously elected Mr. C. R. Fairey, M.B.E., F.R.Ae.S., as President-designate. Mr. Fairey assumed office on October 1st, 1930, and delivered his Presidential Address, "The Growth of Aviation," on Thursday, October 9th, 1930.

Mr. C. R. Fairey, M.B.E., F.R.Ae.S., is one of the early British pioneers in aviation. In 1910 he entered a public competition at a meeting of the Kite and Model Aeroplane Association, and won every event. In 1912-13 he became manager to the Blair-Atholl Syndicate for the making of the Dunne aeroplane and later became Chief Engineer to Messrs. Short Bros. In 1915 he founded the Fairey Aviation Company. Mr. Fairey was Chairman of the S.B.A.C., 1922-24, and a member of the Aeronautical Research Committee, 1923-26.

Vice-Presidents

At the Council Meeting held on the 24th of June, 1930, the elections for Vice-Presidents were made. The three existing Vice-Presidents were re-elected for 1930-31—Air Vice-Marshal Sir Vyell Vyvyan, K.C.B., D.S.O., Lieut.-Col. J. T. C. Moore-Brabazon, M.C., F.R.Ae.S., M.I.Ae.E., and Mr. H. E. Wimperis, C.B.E., F.R.Ae.S. (Director of Scientific Research). Professor L. Bairstow, C.B.E., F.R.S., F.R.Ae.S. (Zaharoff Professor of Aviation, University of London, and Director of School of Aviation, Imperial College of Science and Technology) was elected an additional Vice-President for the same period.

Council

The following is the full Council for 1930-31 :—

President:
Mr. C. R. Fairey, M.B.E., F.R.Ae.S.

Past President:
Colonel The Master of Sempill, A.F.C., F.R.Ae.S.

Vice-Presidents:
Air Vice-Marshal Sir Vyell Vyvyan, K.C.B., D.S.O.
Lieut.-Col. J. T. C. Moore-Brabazon, M.C., F.R.Ae.S., M.I.Ae.E.
Mr. H. E. Wimperis, C.B.E., F.R.Ae.S.
Prof. L. Bairstow, C.B.E., F.R.S., F.R.Ae.S.

Council:

Captain P. D. Acland.
Major T. M. Barlow, M.Sc. (Eng.), M.Inst.C.E., M.I.Mech.E., F.R.Ae.S.
Mr. Robert Blackburn, O.B.E., A.M.Inst.C.E., M.I.Mech.E., F.R.Ae.S., M.I.Ae.E.
Mr. M. L. Bramson, A.C.G.I., F.R.Ae.S., M.I.Ae.E.
Mr. Griffith Brewer, F.R.Ae.S.
Major J. S. Buchanan, O.B.E., A.M.I.Mech.E., F.R.Ae.S.
Major G. P. Bulman, O.B.E., B.Sc., A.F.R.Ae.S.
Wing-Cmdr. T. R. Cave-Browne-Cave, C.B.E., M.I.Mech.E., A.M.I.N.A., F.R.Ae.S.
Captain F. T. Hill, F.R.Ae.S., M.I.Ae.E., B.Sc., Wh.Ex.
Captain A. G. Lamplugh, F.R.Ae.S., M.I.Ae.E.
Mr. W. O. Manning, F.R.Ae.S.
Major R. H. Mayo, O.B.E., F.R.Ae.S.
Mr. T. O. M. Sopwith, C.B.E., F.R.Ae.S.
Mr. C. C. Walker, Assoc.M.Inst.C.E., F.R.Ae.S.
Mr. L. A. Wingfield, M.C., D.F.C., A.R.Ae.S.I.

Hon. Treasurer: Major D. H. Kennedy, O.B.E., F.R.Ae.S.

Hon. Solicitor: Lawrence A. Wingfield, A.R.Ae.S.I.

Hon. Librarian: Mr. J. E. Hodgson.

Hon. Accountant: Mr. A. N. D. Smith, F.I.C.A.

Committees of Council

The following are the Committees of Council for the year 1930-31:—

Grading Committee.

Captain F. S. Barnwell, Mr. R. A. Bruce, Major F. A. Bumpus, Mr. C. R. Fairey, Mr. W. S. Farren, Lieut.-Colonel L. F. R. Fell, Mr. A. Gouge, Captain F. T. Hill, Mr. R. J. Mitchell, Mr. W. P. Savage, Colonel the Master of Sempill, Prof. R. V. Southwell and Dr. H. C. Watts.

Finance Committee.

Mr. E. C. Gordon England, Mr. C. R. Fairey, Captain F. T. Hill, Mr. J. E. Hodgson, Major D. H. Kennedy, Mr. W. P. Savage, Mr. F. R. Simms, Mr. A. N. D. Smith and Mr. L. A. Wingfield.

Informal Discussions Committee.

Major T. M. Barlow, Mr. M. L. Bramson, Major G. P. Bulman, Mr. C. R. Fairey, Mr. F. A. Foord, Mr. D. R. Pye and Mr. C. C. Walker.

Lectures Committee.

Mr. R. S. Capon, Captain F. Entwistle, Mr. C. R. Fairey, Mr. H. Glauert, Major F. M. Green, Mr. S. Scott Hall, Captain G. T. R. Hill, Mr. H. B. Irving, Mr. R. O. King, Mr. M. Langley, Mr. R. K. Pierson, Mr. D. R. Pye and Mr. C. C. Walker.

Joint Standing Committee with the Society of British Aircraft Constructors and the Royal Aero Club.

Colonel the Master of Sempill, Air Vice-Marshal Sir Vyell Vyvyan and Captain A. G. Lamplugh.

EDUCATION AND EXAMINATIONS COMMITTEE.

Major T. M. Barlow, Prof. L. Bairstow, Mr. W. E. Dumbrill, Mr. Eadon, Captain F. T. Hill, Prof. Melvill Jones, Mr. W. M. Page, Dr. N. A. V. Piercy, Mr. H. T. Tizard and Captain G. W. Wilkinson.

REPRESENTATIVES ON OTHER BODIES.

British Engineering Standards Association Aircraft Committee.—Major R. H. Mayo and Dr. H. C. Watts.
Advisory Council of the Science Museum.—Colonel the Master of Sempill.
Central Library for Students.—Mr. J. E. Hodgson.
Students' Section.—Mr. T. Tanner (Honorary Secretary).
Association of Special Libraries and Information Bureau.—Mr. J. E. Hodgson (Hon. Librarian).

Elections

The following were elected members of the Society in the grades indicated on December 10th, 1929:—

Associate Fellows.—William George Gould, Aubrey Lawrence Lingard.
Associate Member.—Harry Thomas Tremelling.
Associate.—Harold Vernon Whiting.
Students.—Reginald Ernest Collins, Ernest Folley, Francis Leslie Hales, William George Hilldrup, Arthur Leslie Holland, Ernest Herbert Lanham, Edward Charles Smith-Ross, Arthur Braybrooke Stutter, Alan Alfred Tier.
Companion.—Percival Phillips.

On January 14th, 1930:—

Associate Fellows.—Walter Browning, Harry Richard Barnes Fitch, William Helmore, Claude Percival Thomas Lipscombe, A. E. Marsden (re-elected), Aldolf Camden Pratt (re-elected), Walter H. Stamford (re-elected), Hubert Charles Henry Townend, Stephen Cecil Woodward.

Associate.—Cyril Turner.

Students.—Calvert Armstrong, Robert Baines Holmes, Alfred Walter Liquorish, Frederick William McCartney, Richard Philip Wildey Morris, Roy James Nixon.

Companion.—Harold Miller Whitehead.

On February 11th, 1930:—

Fellow.—Felix W. Pawlowski.

Member.—Alfred Henry Caple.

Associate Fellows.—Frank Emsley, Ewan Hogan Slattery, Reginald Spencer Stafford (from Student).

Students.—Harold Edward Andrews, George Jeffrey Armstrong, Richard Henry Beeching, Lawrance Valentine Brown, Robert Alfred Copsey Carter, Herbert Aston Clark, Bertram Cornthwaite, William Douglas Gaffney, R. P. Nair, Thomas Pountney, Richard Henry Sainsbury, M. L. Sodhi, Francis Neville Monkhouse Sparks, John Desmond Stratton.

Companions.—Arthur Leighton Angus, George Vincent Carlow (Viscount), Fukumatsu Isikawa, Thomas Arthur Symonds Lloyd.

On March 11th, 1930:—

Fellows.—Sydney Brew (from Associate Fellow), William Lockwood Marsh (from Associate Fellow).

Associate Fellows.—William Robinson Andrews, Desmond Herlouin DeBurgh, Peter Du Cane, John Leslie Emery, Donald Rolfe McWhinnie, Percy Maxwell-Muller, Henry Furnell Peaty, Francis Aubrey Roberts, Stewart Scott-Hall (from Student).

Associates.—The Hon. Lady Mary Bailey, Henry William Dunn, Robert Henry Thomas, Frederick William Victor Webber, Miss Amy Johnson (from Companion).

Students.—Henry Owen Baker, Donald Lambert Brown, Alfred Horace Elkington, Bernard William Locke, Richard Ronald Foster Mann, Alfred William James Norkett, William Stanley Reed, Leslie Charles Richardson, Ivan Morley Williams, William Wilson.

Companions.—John Raymond Ashwell-Cooke, Miss Constance Ruth Leathart, A. F. de Ledesma, Miss Edith Mary Webb.

On April 15th, 1930:—

Associate Fellows.—Robert Boorman, Seaward Newnham Cole, Leslie William Johnson, John Kenworthy, Charles Isted Morris, William George Arthur Perring, Frederick Pilling (from Associate), Harold Bertram Pond (from Associate Member).

Associate Members.—Edmund Neil Boileau Bentley (from Associate), Neal Anthony Ferguson, William George Kentfield.

Associates.—Purshottam Megfhji Kabali (from Student), Ram Keshave Koratkar, Denis Moore Langford, Wilfrid Thomas Morgan, James Graham Woollard.

Students.—Andrew Dent Balmain, Charles William Barraclough, Alfred Owen Waldron Bennett, Daniel Cook, Thomas Dawson, Robert Cecil Hinkin, Lewis Max Jenkins, Reginald Francis Lloyd, Robert McVie, Griffith Henry Richards, Frank Maurice Startup, John Ellis Stevens, Vincent Jacques Willems.

Companions.—Alfred Gordon Berg, Miss Doris Mona Hirst (from Student).

On May 16th, 1930:—

Fellow.—Oliver Edwin Simmonds (from Associate Fellow).

Associate Fellows.—Frank Holroyd, Lachlan Donald Mackintosh, Percy Bickmore Whillier.

Associate.—Henry O'Neil DeHane Segrave.

Students.—Frank Bernard Abbott, William Kenneth Austin, Christopher Henry George Barnes, William George Cox, Edward James Iltid Nicholl, Reginald Alfred Norman, Ian Charles Stuart Rose, Norman Brayford Scott.

On June 24th, 1930:—

Member.—Reginald Rhodes (from Associate Member).

Associate Fellows.—Reginald Arthur Beaumont, Harold Anthony Oaks, Archibald Edward Russell (from Associate Member).

Associates.—Mlle. S. H. M. G. Lippens, Alfred James Nicholas, William Edward Perkins.

Students.—Charles John Adamson, Richard Glyn Jones, Charles William Morris, Samuel McNair Park, Derek Wright.

On July 22nd, 1930:—

Associate Fellows.—Harold Irvin Birds, Roy Patterson Key, Robert Alexander Seaton (from Associate Member), Oliver Thornycroft.

Students.—Alexander Napier Chinnery-Haldane, Thomas William Stafford, William George Steven.

Companion.—William McLellan.

On September 30th, 1930:—

Associate Fellows.—Albert Oliver Adams (from Associate Member), Debrabrata Chakraverti, Air Commodore Hugh Caswall Tremenheere Dowding, Vivian Valentine Max Ernst, Lieut. Carlos Manuel Gadda (from Associate), Air Vice-Marshal Frederick Crosby Halahan, Flight Lieut. James Alexander Gordon Haslam, James Oswald Mortlock (from Student), Captain Andrew Swan, Arthur Edgar Woodward-Nutt (from Student).

Associate Member.—Raymond Vaughan Fowler.

Associates.—Stanley James Gilbert, Charles William Hewitt, Harry Percy Thomas.

Students.—John Searle Drewett, Herbert George Edmonds, Baidya Nath Ghosh, Richard Charles London, George Wilfrid Mullett, Noel Henry Nash, John Alfred Sheppard, Kenneth F. Tupper, John Colin Turnbull, Richard Babington Winn.

On October 28th, 1930:—

Fellow (from Associate Fellow).—William Francis Forbes-Sempill (Colonel the Master of Sempill).

Associate Fellows.—Maurice John Bernard Davy, George Johann Klein.

Associate Member.—Corporal Donald Sydney Nash.

Associates.—Flight Lieutenant Louis Massey Hilton, Percy William Leslie Williams.

Students.—John Paul Bertinat, Miss Mary Lucy Aroha Clifford, Lawrence Ethelbert Hoddle, Cyril William Lawson, Horace Charles Luttman, Charles Van Meerssche, Kenneth James Sewell, Lac. Roy Tomlinson.

On November 18th, 1930:—

Fellow.—Grover Loening.

Associate Fellows.—Earl Dodge Osborn, Fredeirke Brant Rentschler, Eugene Edward Wilson.

Associates.—John Francis Cappleman, Malcolm Sheraton Kuhring, Leslie Walter Nethercott (from Student), Garlies Mitchell Spinks (from Student), Herbert William Victor Steventon.

Students.—Noel Britton, Robert Charles Morgan, Laurence Marshall Pinto, Maurice Frederick Pring-Rowe, Shantaram Nath Shirodker, Thomas Arthur James Spencer.

Annual General Meeting

The Annual General Meeting of the Society was held on March 26th, 1930, in the Offices of the Society.

Present:

President: Colonel the Master of Sempill, in the chair.

Council: Messrs. Acland, Barlow, Bramson, Brewer, Cave-Browne-Cave, Hill, Hodgson, Manning, Vyvyan, Wimperis and Wingfield.

Ordinary Members: Messrs. Balston, Belaiew, Borlase-Matthews, G. L. O. Davidson, Eadon, Foord, Howard-Flanders, Langley, Merton, Pickles and Thurston.

The Secretary, Miss Jarvis and Miss Todd.

The notice convening the meeting was read, and the Minutes of the last General Meeting, having been published in the Journal for April, 1929, were taken as read and signed.

The President, in opening the meeting, said that, acting as the spokesman of the Council, he wished to pay special tribute to the great help the Society had received during the past year from Mr. Fairey, who had made a special donation to the Society's funds for the purpose of increasing the Endowment Fund; to Captain Acland who, as chairman of the S.B.A.C., was largely instrumental for obtaining the generous grant of £500 to the Society for the purposes of the Aero Exhibition at Olympia; to Mr. Handley Page, the present chairman of the S.B.A.C., for his aid in obtaining the continuation of the S.B.A.C. grant of £250 a year; and to Mr. F. R. Simms, of the S.M.M.T., for his help in obtaining a further grant of a similar sum from the S.B.A.C.

Dr. Thurston raised the point of Income Tax rebate which could be obtained by members in the same way as was done by other societies. It was pointed out that certain facilities had already been obtained, and the whole question of Income Tax payable by the Society and its members was under constant review.

The meeting asked that the following letter should be reprinted in the Journal for the information of members:—

Somerset House,
14th August, 1928.

Dear Sir,

Further to your interview with Mr. Stanley at this office on the 19th July, I am now in a position to inform you that the Board of Inland Revenue will not raise objection to the allowance as an expense for Income Tax purposes of annual subscriptions paid by members who are

(i) Assessable under Schedule D of the Income Tax Acts in respect of professional or trading profits, subject to the decision of the Commissioners who make the assessment that such subscriptions are sufficiently closely related to the business carried on; or

(ii) Assessable under Schedule E in those cases only in which continual membership of the Society is an essential condition of the terms of appointment.

Yours faithfully,
GEO. WILCOCK,
Principal Inspector of Taxes.

Capt. J. L. Pritchard, *Secretary*,
Royal Aeronautical Society.

A discussion followed on the awards of medals and prizes to Members of Council. Opinion was divided and the matter was referred back to the Council for further consideration.

In seconding the adoption of the Council's Report, Sir Vyell Vyvyan said that there was no question that the progress of the last few years had been in a very large measure due to the untiring energy of the Master of Sempill. He had never spared himself, and the Society was to be congratulated on the President it had.

Mr. Wimperis proposed, and Captain Acland seconded, that Messrs. Price, Waterhouse and Co. be re-appointed auditors. The resolution was carried unanimously.

The following were appointed scrutineers for elections to Council: Messrs. Balston, Foord, Langley, Manning and Pickles.

As a result of the ballot the following members were declared elected to serve on the Council for the years 1930-1932:—Captain P. D. Acland, Professor L. Bairstow, Mr. M. L. Bramson, Major J. S. Buchanan, Major E. P. Bulman, Mr. C. R. Fairey, Captain F. T. Hill, Captain A. G. Lamplugh, Lieut.-Colonel J. T. C. Moore-Brabazon, Mr. L. A. Wingfield.

A vote of thanks was accorded to the Chairman and the Scrutineers for their services, and the meeting closed.

Lectures

The following Lectures were read before the Society in 1930:

January 9th.—Mr. Mackinnon Wood, F.R.Ae.S., "The New American Wind Tunnels."

January 23rd.—Mr. H. B. Howard, A.F.R.Ae.S., "Airworthiness Certificates."

February 6th.—J. W. Maccoll, B.Sc., PhD., A.F.R.Ae.S., "Modern Aerodynamic Research in Germany."

February 13th.—Senor J. de la Cierva, "The Autogiro."

February 19th.—Dr. W. Georgii and Herr Stamer, "Gliding."

February 27th.—Mr. A. J. Rowledge, F.R.Ae.S., "Latest Developments in Aero Engines."

March 6th.—Major F. M. Green, O.B.E., M.Inst.C.E., F.R.Ae.S., and Mr. H. C. H. Townend, A.F.R.Ae.S., "Resistance of Air-Cooled Engines and the Townend Ring."

March 10th.—Herr M. Wronsky, "Air Transport in Germany."

April 3rd.—Mons. P. Grimault, "The Technical Organisation of the Compagnie Generale Aeropostale."

May 30th.—Mr. H. R. Ricardo, F.R.S., F.R.Ae.S., "The Development and Progress of the Aero Engine" (Wilbur Wright Memorial Lecture).

October 9th.—Mr. C. R. Fairey, M.B.E., F.R.Ae.S., "The Growth of Aviation."

October 23rd.—Mr. F. W. Meredith, "Air Transport in Fog."

November 13th.—Mr. H. L. Stevens, A.F.R.Ae.S., "Testing Aeroplane Controls."

November 20th.—Captain H. Swan, A.F.R.Ae.S., "Recent Developments in Engine Cooling."

December 4th.—Mr. H. Glauert, M.A., F.R.Ae.S., "The Use of Small Wind Tunnels in Aeroplane Design."

December 11th.—Mr. D. R. Pye, M.A., F.R.Ae.S., "The Origin and Development of Heavy Oil Engines."

The following is a list of the principal lectures before the Branches:—

January 16th.—Yeovil Branch, "Wireless Apparatus for Aircraft," A. B. Carr.

January 16th.—Coventry Branch, "A New System of Wing Construction," H. J. Stieger, A.F.R.Ae.S.

January 23rd.—Yeovil Branch, "Wapiti Steel Wing Construction," by Brian L. Martin, B.Sc., A.F.R.Ae.S.

February 6th.—Yeovil Branch, "Aircraft Production Methods," D. B. Nivison.

February 7th.—Hull and Leeds Branch, "Aircraft as they ought to be," C. G. Grey.
February 14th.—Yeovil Branch, "The Schneider Trophy Contest of 1929," Flying Officer H. R. W. Waghorn.
February 20th.—Yeovil Branch, "The Westland Wapiti in Iraq," Squadron Leader J. J. Breen, R.A.F.
February 20th.—Coventry Branch, "The Winning of the 1929 Schneider Trophy Contest," Flying Officer H. R. W. Waghorn.
February 27th.—Yeovil Branch, "Racing Seaplanes," F. R. Holroyd.
March 6th.—Halton Branch, "Wind Tunnel and Slotted Wings," Mr. Russell.
March 7th.—Yeovil Branch, "The Gypsy Aero Engine."
March 7th.—Hull and Leeds Branch, "Aerodynamic Theory," H. Glauert.
March 10th.—Halton Branch, "Diesel Engines in Aircraft," A. E. L. Chorlton, C.B.E., F.R.Ae.S.
March 11th.—Manchester Branch, "Loads on Aircraft in Flight," H. N. Horne.
March 17th.—Halton Branch, "Metal Construction of Aircraft."
March 18th.—Manchester Branch, "Welding as Applied to Aircraft Structures," R. F. Taylor.
March 19th.—Coventry Branch, "New Airships' Machinery," Wing Comdr. T. R. Cave-Browne-Cave.
March 19th.—Yeovil Branch, "High Altitude Equipment for Aircraft," Major Stewart.
March 25th.—Manchester Branch, "Performance of Aeroplanes," W. R. Andrews.
March 27th.—Yeovil Branch, "Aircraft Accessories."
April 1st.—Manchester Branch, "Economical Application of Die Casting," F. C. Fisher.
April 4th.—Yeovil Branch, "High Altitude Equipment of Aircraft," Major C. J. Stewart, O.B.E., F.R.Ae.S.
April 8th.—Manchester Branch, "The General Method of Testing Aircraft Materials," F. Paxton.
April 15th.—Manchester Branch, "Some Notes on Airscrews and Undercarriages," H. Rogerson
May 29th.—Coventry Branch, "Light Planes and Gliders," Squadron Leader H. Probyn, D.S.O., and Flight Lieut. C. Crawford.
June 16th.—Oxford Branch, "The Economics of Civil Aviation," Major F. M. Green, O.B.E., F.R.Ae.S.
September 15th.—Halton Branch, "Flying Boats and Seaplanes," J. H. Lower, A.F.R.Ae.S., A.M.I.N.A.
October 17th.—Yeovil Branch, "Gliding and Soaring," Colonel the Master of Sempill.
October 23rd.—Yeovil Branch, "Model Aeroplanes," E. Wors, Esq.
October 27th.—Halton Branch, "The Rolls-Royce 'P' Engine," R. A. A. Rubbra, B.Sc.
October 31st.—Hull and Leeds Branch, "The Iris III Cruise to Iceland," Squadron Leader J. H. Jones.
November 6th.—Coventry Branch, "Metal Construction," H. N. Wylie, F.R.Ae.S.
November 14th.—Manchester Branch, "The Age of Speed," Messrs. A. Herbert, Ltd.
November 17th.—Oxford Branch, "The Growth of Aviation," C. R. Fairey, Esq., M.B.E., F.R.Ae.S.
November 20th.—Yeovil Branch, "Aircraft Detail Design—The Shop's Viewpoint," W. Geo. Gibson, Esq., A.R.Ae.S.

November 28th.—Manchester Branch, " Gliding," Colonel the Master of Sempill.
November 28th.—Yeovil Branch, " Westland Wapiti in India," Group Captain R. H. Verney, O.B.E.
November 28th.—Hull and Leeds Branch, " The Importance of the Boundary Layer," H. Glauert, F.R.Ae.S.
December 9th.—Manchester Branch, " The Development of Air-Cooled Aero Engines," J. C. Briggs, Esq.
December 12th.—Yeovil Branch, " Float and Boat Seaplanes," Mr. Jackson of Messrs. Short Bros.

Students' Section

The following Lectures were read before the Students' Section during the year:—

January 28th.—" Parachutes," G. Nelson.
February 18th.—" American Aeronautics," S. Hansel.
November 11th.—" Engines," Mr. H. T. Tizard, C.B., A.F.C., F.R.S., F.R.Ae.S.
December 2nd.—" Commercial Uses of a Four-Foot Wind Channel," S. D. Davies.
December 10th.—" The Salt and Anodic Baths for the Heat Treatment of Dural," A. D. Balmain.

Wilbur Wright Memorial Lecture

On 30th May, 1930, in the Lecture Theatre of the Royal Society of Arts, the Eighteenth Wilbur Wright Memorial Lecture was read by Mr. H. R. Ricardo, F.R.S., F.R.Ae.S., M.I.A.E., Assoc.M.Inst.C.E., on " The Development and Progress of the Aero Engine." Colonel the Master of Sempill, A.F.C., A.F.R.Ae.S., President of the Royal Aeronautical Society, occupied the chair, and a large and distinguished audience was present.

The Annual Council Dinner was held after the lecture, at the Athenæum, and following is a list of Council and their guests who were present:—

Colonel the Master of Sempill (President) in the chair; Air-Marshal Sir John F. A. Higgins, K.C.B., K.B.E., D.S.O., A.F.C. (Air Member for Supply and Research); Sir Richard T. Glazebrook, K.C.B., F.R.S., F.R.Ae.S. (Chairman of the Aeronautical Research Committee); F. Handley Page, Esq., C.B.E., F.R.Ae.S. (Chairman of the Society of British Aircraft Constructors, Ltd.); Lieut.-Colonel M. O'Gorman, C.B., D.Sc., M.Inst.C.E., M.I.Mech.E., M.I.E.E., M.I.A.E., F.R.Ae.S. (Vice-Chairman of the Royal Aero Club); Gerald Merton, Esq., M.C., M.A., Ph.D., F.R.Ae.S. (Chairman of the Air League of the British Empire); Loughnan Pendred, Esq., M.I.Mech.E. (President of the Institution of Mechanical Engineers); E. H. Blake, Esq. (President of the Society of Motor Manufacturers and Traders, Ltd.); H. R. Ricardo, Esq., F.R.S., F.R.Ae.S., M.I.A.E., Assoc.M.Inst.C.E.; Air Vice-Marshal Sir W. Sefton Brancker, K.C.B., A.F.C., F.R.Ae.S.; Air Vice-Marshal Sir Vyell Vyvyan, K.C.B., D.S.O.; H. E. Wimperis, Esq., C.B.E., F.R.Ae.S.; Lieut.-Colonel J. T. C. Moore-Brabazon, M.C., F.R.Ae.S., M.I.Ae.E.; Capt. P. D. Acland; Professor L. Bairstow, C.B.E., F.R.S., F.R.Ae.S.; Major T. M. Barlow, M.Sc.(Eng.), M.Inst.C.E., M.I.Mech.E., F.R.Ae.S.; M. L. Bramson, Esq., F.R.Ae.S., M.I.Ae.E.; Griffith Brewer, Esq., F.R.Ae.S.; Major J. S. Buchanan, O.B.E., F.R.Ae.S., A.M.I.Mech.E.; Major G. P. Bulman, O.B.E., B.Sc., A.F.R.Ae.S.; Wing Commander T. R. Cave-Browne-Cave, C.B.E., F.R.Ae.S. M.I.Mech.E., A.M.I.N.A.; C. R. Fairey, Esq., M.B.E., F.R.Ae.S.; Capt. F. T. Hill, F.R.Ae.S., M.I.Ae.E.; Capt. A. G. Lamplugh, F.R.Ae.S., M.I.Ae.E.; W. O.

Manning, Esq., F.R.Ae.S.; C. C. Walker, Esq., F.R.Ae.S., Assoc.M.Inst.C.E.; L. A. Wingfield, Esq., M.C., D.F.C.; Major D. H. Kennedy, O.B.E., F.R.Ae.S.; and J. E. Hodgson, Esq.

During the evening the following presentations were made:—

To Sir Richard Glazebrook, Chairman of the Aeronautical Research Committee, a Silver Box bearing the inscription:—

> "30th April.—Presented to Sir Richard Glazebrook, K.C.B., F.R.S., F.R.Ae.S., by the President and Council of the Royal Aeronautical Society, to commemorate the Twenty-first Anniversary of the founding of the Advisory Committee for Aeronautics, 30th April, 1909."

To Lieut.-Colonel J. T. C. Moore-Brabazon (a Vice-President of the Royal Aeronautical Society), a Silver Aneroid bearing the inscription:—

> "2nd May, 1930.—Presented to Lieut.-Colonel J. T. C. Moore-Brabazon, M.C., F.R.Ae.S., M.I.Ae.E., by the President and Fellow Members of Council of the Royal Aeronautical Society, to commemorate the Twenty-first Anniversary of his flight on 2nd May, 1909—the first flight in a power-driven aeroplane piloted by a British subject in the British Isles."

The following telegrams were sent and received on this occasion:—

To Mr. ORVILLE WRIGHT.

> Once again we are privileged to pay homage to the memory of your distinguished brother, and we also wish to express great pleasure in the knowledge that you are still playing a prominent part in the development of aeronautics.
>
> The memorial lecture this year deals with aircraft engine development, a peculiarly appropriate subject, since the name of Wright will be handed down to posterity as that of the first person in the world to pilot a power-driven aeroplane.
>
> We would welcome observations on the horse-power you found necessary to make the first flights.
>
> SEMPILL, *President.*

From Mr. ORVILLE WRIGHT

> Greetings to Members assembled for the Wilbur Wright Lecture. Answering inquiry, our nineteen three estimate of power required for flight of Kitty Hawk machine was a little over nine horse-power at twenty-five miles per hour. In flight the motor developed approximately twelve horse-power and the actual speed of machine, according to our measurements, was thirty-one miles per hour.
>
> ORVILLE WRIGHT.

Endowment Fund

A sum of £18 9s. 6d. was received during the year from Messrs. Gale and Polden to the Endowment Fund. Messrs. Gale and Polden have very generously agreed to pay a certain percentage of their profits arising from the sale of the Aeronautical Diary to the Endowment Fund each year.

The attention of all members and all those who are interested in the scientific and technical progress of aviation is drawn to the Endowment Fund.

The object of this fund is to provide the Society with a suitable building, including a Lecture Hall of its own and a sufficient income for its upkeep. That income should be such that the Society is independent of outside support.

Now that the Guggenheim Fund has come to an end and with it its very generous contribution of £1,000 a year to the funds of the Society, it becomes a vital matter, if the Society is to be enabled to continue its activities on the scale of the past few years, that the Endowment Fund should be increased at a much more rapid rate than it has been in the past.

The fund now stands at £1,483 2s. 0d. It was inaugurated in 1926 and in this connection the following is an extract from a letter received by the President from H.R.H. the Duke of York, a patron of the Society:—

> "The work of the Society is growing constantly in magnitude and importance. Its position can be maintained and improved only if all those connected either directly or indirectly with aeronautics give their fullest support. I hope that those public-spirited persons or bodies who have in the past done so much to help forward other societies will give assistance so that a substantial Endowment Fund may be established."

The powerful position many other scientific and technical societies have reached is very largely due to their Endowment Funds (or their equivalents). Such funds have enabled them to develop and maintain and foster that independence of spirit which is so necessary for scientific progress, which ultimately redounds so much to the standing of the profession concerned. And such is the aim of the Council of the Royal Aeronautical Society.

The future of any society lies in the hands of its members. The growth of the Endowment Fund will ensure that future, will bring an ultimate prestige which comes from the spirit which is independent of fluctuations of income. It is hoped, therefore, that every member will seek every opportunity, in the words of H.R.H., "to give their fullest support . . . so that a substantial Endowment Fund may be established."

Secretary's Visit to Canada

In June and July the Secretary visited Canada and the United States of America to make the personal acquaintance of as many as possible of the members there, to open up new channels of exchange of information, and to inquire into the possibilities of the formation of a branch or branches in Canada. He received not only a very warm welcome from all those members whom he met, but unstinted help in the course of his inquiries. There is every possibility of one or more branches being formed in Canada as a result of his visit and the co-operation of Canadian members and the Engineering Institute of Canada. A brief account of the visit will be published in an early issue of the Journal.

The Master of Sempill

Colonel the Master of Sempill, who was succeeded on October 1st, 1930, as President by Mr. C. R. Fairey, first joined the Society in 1917, and was elected a member of Council in April, 1921, upon which he served continuously until his election as Chairman of the Society in 1926. From October of that year until September 30th, 1930, the Master of Sempill has acted as Chairman (President from 1st January, 1928), being specially re-elected President at meetings of Council held on 8th May, 1928, and 10th May, 1929.

The election of the Master of Sempill to the highest office in the Society was coincident with a great increase in the activities of the Society. The new President devoted all his intense energy to raising the prestige of the Society and increasing its work in all directions. The following figures serve as an eloquent testimony to the Master of Sempill's lively interest in the work he had undertaken. During his period of office there have been fifty Council

meetings, of which he presided at all except one. Eighty lectures were delivered before the Society, at seventy-nine of which the President was in the chair. In addition to that there have been innumerable Committee meetings, meetings with other Societies and Institutions, official dinners and lunches, and informal discussions, at which Colonel Sempill has been present on behalf of the Society. These figures alone constitute a record which has rarely been equalled.

It is difficult to estimate the debt the Society owes the Master of Sempill. I have served on the Council with him since he was elected, have served under him as Secretary during all the difficult years he has been Chairman and President. I have, therefore, come into more close contact with him than perhaps any other member of the Society, and have seen his methods of working. During all these years I have called upon him times without number for help and advice which has been given at once and ungrudgingly, often at great personal inconvenience to himself. During his period of office the Society was always first and his own personal activities second. His powers of organisation, his constant kindness and charm, his unfailing consideration for all with whom he came in contact, have proved assets to the Society which can only be fully realised now that the time has come when, under the Rules of the Society, he must relinquish the reins of office. In any history of the Society the years 1926-1930 will prove to be among the most important since its foundation in 1866. And not a little of the progress which has been made will be found to be due to the Master of Sempill.

The amalgamation with The Institution of Aeronautical Engineers; the organisation of the Society's Exhibit at the Aero Exhibition of 1929; and the increased prestige of the Society are lasting monuments to the work he has done.

J. L. P.

Dinner to The Master of Sempill

On Tuesday evening, November 18th, a dinner was given to Colonel the Master of Sempill, A.F.C., F.R.Ae.S., Past-President, by those members of Council who had served under him during his period of office from 1926-1930. The dinner was held at the Army and Navy Club in Pall Mall and was presided over by Mr. C. R. Fairey, M.B.E., F.R.Ae.S., President of the Society.

As is well known, during the years that Colonel the Master of Sempill has been President, the growth of the Society has been most remarkable and the Council unanimously decided to pay him the signal honour of a special dinner on his retirement and at the same time to give him a permanent souvenir of their appreciation of his untiring energy and devoted services on behalf of the Society. Colonel the Master of Sempill was presented with a case of cutlery suitably inscribed and engraved. During the evening many messages were read expressing regret at the retirement of the Master of Sempill. They included the messages from the two Patrons of the Society, H.R.H. the Prince of Wales and H.R.H. the Duke of York, and also from members of the Society, including Sir Joseph Petavel, Mr. Orville Wright, Lord Wakefield, Major Lester Gardner, Mr. Edward Warner and many others. Some of these messages were as follows:—

From H.R.H. the Prince of Wales.

> I hear that you are on the point of retiring, under the Rules, from the Presidency of the Royal Aeronautical Society. As Patron I have followed with interest the work of the Society during your period of office and know that much of the progress made of late has been due to your constant zeal for the Society's welfare and your energy on its behalf.
>
> EDWARD P.

From H.R.H. the Duke of York.

Dear Sempill,—As Patron of the Royal Aeronautical Society, I have learnt with regret of your retirement under the Rules from the Presidency.

I have followed with keen interest the work of the Society during the period you have been President, and I realise that much of the progress which has been made during that period is due to your constant zeal for the Society's welfare and your own untiring energy on its behalf.

Yours sincerely,
(Signed) ALBERT.

From Lord Wakefield.

Dear Mr. Fairey,—I am very glad to know that the members of Council who have served under him during the past four years are uniting under your chairmanship to do honour to Colonel the Master of Sempill on his retirement from the Presidency of your historic Society. I have a very great admiration for the Master of Sempill, who has done such magnificent work for British aviation during his career and under whose leadership the Royal Aeronautical Society has added lustre to its already splendid reputation.

At this time in particular we can ill afford to lose the services of anyone who has so much knowledge, skill and enthusiasm as inspires the Master of Sempill. We can, however, be absolutely certain that in many different ways he will continue to help forward the development of flying in England and throughout the Empire, and I will now ask you to allow me to join with you in offering him hearty thanks for the work he has done as President of the Society.

With all good wishes for a very successful period of office,

I am, yours sincerely,
(Signed) WAKEFIELD OF HYTHE.

From Major Lester Gardner.

Please convey to Council sincere personal regret on occasion retirement Colonel Master of Sempill. His untiring and able efforts have brought new International fame to our distinguished Society; all will hope that his energetic ability may always be available and that Dick Fairey may still further increase the world-wide reputation of the Society for service to aeronautics.

LESTER GARDNER.

From Mr. Edward Warner.

Delighted to have opportunity participating in expression of American members affection for Sempill. I believe Gardner is sending joint message, but I want to contribute my personal word of esteem also.

EDWARD WARNER.

From Major B. Baden-Powell (Past-President).

May I, as an old member of the Society, join in expressing appreciation of the services rendered by the retiring President, Colonel the Master of Sempill, during his period of office. I am sure we all realise how very efficiently he has carried out his duties, and how much he has done to enhance the prestige of the Society.

Yours sincerely,
(Signed) B. BADEN-POWELL.

The following present and past members of Council attended the dinner:—Captain P. D. Acland, Prof. L. Bairstow, C.B.E., Major T. M. Barlow, F.R.Ae.S., Mr. M. L. Bramson, F.R.Ae.S., Mr. Griffith Brewer, F.R.Ae.S.,

Major J. S. Buchanan, F.R.Ae.S., Major G. P. Bulman, A.F.R.Ae.S., Wing Commander T. R. Cave-Browne-Cave, Mr. C. R. Fairey, M.B.E., F.R.Ae.S., Captain F. T. Hill, F.R.Ae.S., Captain G. T. R. Hill, M.C., Mr. H. B. Irving, A.F.R.Ae.S., Major D. H. Kennedy, O.B.E., F.R.Ae.S., Captain A. G. Lamplugh, F.R.Ae.S., Mr. W. O. Manning, F.R.Ae.S., Major R. H. Mayo, O.B.E., Lieut.-Colonel M. O'Gorman, C.B., Mr. Handley Page, C.B.E., Captain J. Laurence Pritchard, Mr. F. R. Simms, M.I.Ae.E., Air Vice-Marshal Sir Vyell Vyvyan, K.C.B., D.S.O., Mr. H. T. Vane, Mr. C. C. Walker, F.R.Ae.S., Mr. L. A. Wingfield, M.C., Mr. R. McKinnon Wood, O.B.E.

Major B. F. S. Baden Powell

The following is an extract from the Council Minutes of April 21st, 1880:—

"At a Meeting of the Council of the Aeronautical Society held at Stafford House, April 21st, 1880, there were present Mr. Glaisher, Mr. Wright, Mr. Wenham and Mr. Breary. The following gentlemen were elected members:—

Henry Novra.
Rev. S. Behrens.
B. F. S. Baden Powell.
Howard Lane.
A. H. H. Jeyse.
Paul Pfeiderer."

The membership at that time was exactly 80 and included such well-known names as James Glaisher, Otto Lilienthal, Thomas Moy, John Stringfellow and P. H. Wenham.

Major B. F. S. Baden Powell, now an Honorary Fellow of the Society, is the oldest living member, and from the above extract it will be seen that on Monday, April 21st, 1930, he completed fifty years continuous membership, a remarkable record. In 1892 Major Baden Powell attended his first meeting as Member of Council, and from then onwards delivered many papers before the Society and took part in the discussions on many others. Between May, 1892, and November, 1896, the Society was barely existing. At the latter Council Meeting Major Baden Powell agreed to act as Honorary Secretary. The balance in hand was £5 5s. 0d. The new Hon. Secretary immediately began to increase interest in the Society. The Journal, which had lapsed, was issued quarterly under his editorship, and he was elected an Honorary Member of the Society. It is interesting to note that in March, 1897, Major Baden Powell reported that the number of members was 39, including 4 honorary members, and the balance in hand was £15. A note in the Council Minutes says "The Society did not possess sufficient funds to provide a suitable Quarterly Journal without outside support. However, the Hon. Secretary (Major B. F. S. Baden Powell) suggested issuing such a Journal entirely at his own expense and risk."

At the Meeting of Council held on December 6th, 1899, the following resolution was passed, following Major Baden Powell's departure for South Africa on the outbreak of War.

"The Council of the Aeronautical Society at this meeting to-day, take this, the earliest opportunity since the departure of Major B. F. S. Baden Powell on service in South Africa, to record their best thanks to him for the great interest he has shown in the affairs of the Society, and for the very efficient manner in which he has conducted the duties of Hon. Secretary. The Council look forward in giving Major Baden Powell a hearty welcome on his return to England."

It was stated in a succeeding minute that Major B. F. S. Baden Powell, when he became Hon. Secretary, virtually re-established the Society. In July, 1900, Major Baden Powell was elected President of the Society, a post he held for seven years. On his resignation in 1907, the following letter was sent to him by the Vice-President, Lt.-Col. F. Trollope:—

"My dear Baden Powell,

I am requested by the Council of the Aeronautical Society of Great Britain to convey to you the thanks of the Society for the valuable services you have rendered during your seven years term of office as President.

On behalf of the Society allow me to give you our thanks for the work you have done, and to express our pleasure, that as a member of the Council, we shall still have the benefit of your advice in matters affecting the welfare of the Society."

In 1908 Major Baden Powell was elected a Vice-President of the Society.

Major Baden Powell was one of the first to experiment with man-lifting kites, and, as stated in the Journal (April, 1897), "the first well-authenticated occasion on which a man was raised by a kite was on June 27th, 1894, when Captain Baden Powell, Scots Guards, conducted some experiments at Pirbright Camp." Major Baden Powell read a number of papers before the Society on his kites, and, as is well-known, his system of kites was adopted by the army authorities for some time. Previously, Major Baden Powell was a leading spirit in military ballooning. During the Boer War Major Baden Powell's kites were successfully used for reconnaissance, photography and wireless. It was in 1881 that Major Baden Powell made his first balloon ascent, and in 1884 he bought the balloon Eclipse, and made several ascents in it at Aldershot. In 1887 he began his experiments with kites, but it was not until 1892 he began his systematic series of experiments, which culminated in the success of June, 1894. In March, 1898, Major Baden Powell read an exhaustive paper before the members of the Society of Arts on "Kites in Theory and Practice," for which he obtained the Society's silver medal.

The then President of the Society did not neglect the heavier-than-air craft. In March, 1904, he read a paper on "Experiments with Aerial Screw Propellers" before the Society, and reference to the April Journal of that year shows how methodically the experiments were carried out. Actually 350 tests were carried out on various types of airscrews.

In the Journal for July, 1904, Major Baden Powell describes at length his experiments with gliders at the Crystal Palace, with a view to building a power-driven aeroplane. In these experiments it is worthy to record that Major Baden Powell's most enthusiastic helper was a Mr. J. T. C. Moore-Brabazon, who carried out many of the preliminary glides. The Journal during the period Major Baden Powell was acting as Hon. Secretary or President contains many articles from his pen, all of which, in some form or other, indicated his firm belief that the conquest of the air was close at hand, and by his optimism he infused new life and energy into the sick child of aviation. It is, indeed, no exaggeration to say, that Major Baden Powell was one of those far-sighted men who helped to bring that child up to a sturdy manhood.

One fact of which Major B. F. S. Baden Powell is justly proud is that he flew with Wilbur Wright on October 8th, 1908, being the second Englishman to fly. The first was Mr. Griffith Brewer, who flew on the same day with Mr. Wilbur Wright shortly before Major Baden Powell.

Major B. F. S. Baden Powell joined the Aeronautical Society of Great Britain before the majority of its present members were born. He not only saved it from extinction, but when he laid down the reins of office after fifteen years

continuous work as a member of Council, Honorary Secretary and President, he saw it was well on its way to the position it now holds as the most authoritative body of its kind in the world.

The following telegram was sent by the President on behalf of the Society to Major B. F. S. Baden-Powell on the completion, on April 21st, of fifty years' continuous membership of the Society:—

> "Very cordial congratulations Mister Past President from the Council and Members of the Royal Aeronautical Society on the 50th anniversary, Monday, the twenty-first, of your membership. Your splendid services to aeronautics and to the oldest Aeronautical Society in the world will never be forgotten.—SEMPILL, *President*."

At the Council Meeting held on April 15th the following resolution was unanimously passed:—

> "The Council in recording in their minutes that on April 21st, 1930, Major B. F. S. Baden-Powell, a former President of the Society and for many years a Member of Council, had been a member of the Society for fifty years, wish to extend their heartiest good wishes to him for the future, and to congratulate him upon the completion of a record unique in the Society's history."

R 101 Disaster

Many messages have been received from all over the world by the Society, both from its own members and from private individuals as well as foreign institutions, expressing the deepest sympathy with the relatives of those who lost their lives and with the Society at the loss of some of its most brilliant members in the R.101 disaster. A wreath was sent to Cardington on behalf of the Council and all members of the Society.

Among the letters and telegrams of sympathy received were those from Colonel N. Belaiew; J. Benson, Esq.; Count Bernstorff; William G. Cox, Esq.; Dr. Hugo Eckener; Major Lester D. Gardner; Professor W. Georgii; Professor R. Giacomelli; Harry F. Guggenheim; Mr. Halle, of the Royal Norwegian Aero Club; Doctor Kiep; R. Langer, Esq.; R. M. Morrison, Esq.; W. Stern, Esq.; Herman Volk, Esq.; Edward Warner, Esq.; the Wissenschaftliche Gesellschaft fur Luftfahrt; Associazione Italiana Aerotecnica; the 1er. Congrès International de la Sécurité Aérienne; the Institution of Automobile Engineers; Institut der Rhon-Rossitten-Gesellschaft, Wasserkuppe.

The President and Council wish once more to thank all those who have sent messages of sympathy on the occasion of the greatest disaster to British aviation.

Obituaries of those members of the Society who lost their lives in the disaster were printed in the November Journal.

R 101 Inquiry

Lieut.-Colonel Moore-Brabazon, a Vice-President of the Society, was appointed one of the two Assessors to the Court of Inquiry into the R.101 disaster.

BRANCHES

Gloucester and Cheltenham Branch

A new branch of the Society was formed on November 14th, with Mr. H. P. Folland as Chairman and Mr. Nethercott as Secretary. At the inaugural meeting on that date it was stated that the membership was confidently expected to be between 100 and 200.

Yeovil Branch

The membership of the Yeovil Branch now stands at over 350. The Council feel that Mr. Gaunt, the Hon. Secretary of the Branch, and all its energetic officials, are to be heartily congratulated, not only upon the fine membership, but upon the very excellent series of lectures which have been read before the Branch. The work of running the Branch has become so heavy that it has been found necessary to appoint a special Secretarial Assistant, Mr. C. J. King. A very successful series of Instructional Classes for Ground Engineering has formed a part of the activities of the Branch.

On 30th May the Westland Aircraft Works were honoured by an impromptu visit of H.R.H. the Prince of Wales, on his way back to London from Torquay. The Prince was flying in his private " Moth " with Squadron Leader Don, and accompanied by Sir Lionel Halsey piloted by Flight Lieut. Fielden. His Royal Highness was welcomed by Mr. R. A. Bruce, Managing Director, and by Flight Lieut. Paget and Mr. Byron, and the Prince and his party were taken round the aircraft shops.

Manchester Branch

The Manchester Branch was re-organised at the beginning of the year on the lines of the remaining Branches of the Society. The new President of the Branch is Mr. J. D. Siddeley, and the other officers and Committee are:—

Chairman: Mr. R. Chadwick.
Hon. Secretary: Mr. F. Paxton.
Assistant Hon. Secretary: Mr. J. Colley.
Treasurer: Mr. A. D. Scarlett.
Committee: Messrs. Andrews, Cameron, Gaskin, McCormick, Oldham, Shawley, Taylor and Welch.

Already the reorganisation has increased the membership to over a hundred under the active and enthusiastic guidance of Mr. Chadwick. A model aeroplane section has been formed and a gliding section is under consideration.

AWARDS

Silver Medal

The Silver Medal of the Society for the year 1929-30 was awarded to Mr. (now Sir) F. H. Royce for his conspicuous work in the development of the Rolls-Royce aero engines, and in particular the engine of the winning Schneider Trophy machine in 1929—the S.6.

R.38 Memorial Prize

The R.38 Memorial Prize for 1929 was awarded to Miss Lyon for her paper entitled " The Strength of Transverse Frames of Rigid Airships." The paper was published in the Journal for June, 1930.

Akroyd Stuart Memorial Prize

The Akroyd Stuart Memorial Prize was awarded to Mr. D. R. Pye, M.A., F.R.Ae.S., by the Council, following the report of the referees, Professor Dolby, Professor A. N. Gibson and Wing Comdr. T. R. Cave-Browne-Cave.

Usborne Memorial Prize

The Usborne Memorial Prize for 1929 was awarded to Mr. S. H. Evans for his paper, entitled " The Cross-Section of the Semi-Rigid Airship." The paper was published in the Journal for August, 1930.

Elliott Memorial Prize

The Council awarded the Elliott Memorial Prize of the Society for the half-year ended June, 1930, to Leading Aircraftsman R. A. C. Carter, who obtained highest marks in the passing-out examinations.

Fifth International Air Congress

The following papers were presented through the Society to the Vth International Air Congress which was held at The Hague from 1st to 6th September, 1930:—

Flying and Landing in Fog, by R. S. Capon, Esq., B.A., F.R.Ae.S.

The Uses and Limitations of Mechanical Tests, by W. D. Douglas, Esq., F.R.C.Sc.I., F.R.Ae.S.

Air-Cooled Compression Ignition Engines, by A. H. R. Fedden, Esq., F.R.Ae.S.

Aeronautical Research in England. The Aeronautical Research Committee, 1920-30, by Sir Richard Glazebrook, K.C.B., F.R.S., F.R.Ae.S.

The Present-Day Requirements for Aerodrome and Air Route Lighting, by Dr. W. M. Hampton, Ph.D., F.Inst.P., and Captain C. E. Ward.

Airscrew Body Interference, by C. N. H. Lock, Esq., A.F.R.Ae.S.

Problems of Air Transport from the Pilot's Point of View, by Captain N. Macmillan, M.C., A.F.C., A.F.R.Ae.S., A.M.I.Ae.E.

The Ground Organisation required by Air Transport, by Major R. H. S. Mealing, A.R.Ae.S.I.

Experiments in a Model Tank as a Basis for the Design of Floats and Flying Boats, by R. J. Mitchell, Esq., F.R.Ae.S.

The Effect of Engine Gearing on Aircraft Performance, by R. K. Pierson, Esq., B.Sc., A.M.Inst.C.E., F.R.Ae.S.

The Compressed Air Tunnel under Construction at the National Physical Laboratory, by E. F. Relf, Esq., F.R.Ae.S.

The Townend Ring, by H. C. H. Townend, Esq., B.Sc., A.F.R.Ae.S.

Responsibilities of the Pilot and Navigator under the Warsaw Convention, by L. A. Wingfield, Esq., M.C., D.F.C., A.R.Ae.S.I.

International Commission for the Study of Motorless Flight

At the International Commission for the Study of Motorless Flight, which sat at Frankfurt on 14th June, 1930, Colonel the Master of Sempill, Past-President of the Royal Aeronautical Society, was elected a Vice-President of the International Soaring Flight Committee which was formed on that occasion.

Imperial College of Science and Technology

Mr. C. R. Fairey, President of the Society, has been re-appointed to represent the Society as a Trade Member on the Advisory Committee on Aeronautical Education of the Imperial College of Science and Technology, South Kensington, for a further period of four years.

British Gliding Association

Colonel the Master of Sempill, the Society's representative on the Council of the British Gliding Association, was elected a Vice-President of the Association.

Segrave Memorial Fund

A fund was started to establish a Trophy in memory of the late Sir Henry Segrave, to be known as the "Segrave Award for Achievement on Land, Water, or in the Air."

The Council wish to acknowledge the following contributions to the Fund:—

	£	s.	d.
Messrs. Rolls-Royce, Ltd.	105	0	0
Messrs. Fairey Aviation Company, Ltd.	26	5	0
Messrs. Blackburn Aeroplane Co., Ltd.	25	0	0
Messrs. De Havilland Aircraft Co., Ltd.	10	0	0
Messrs. Westland Aircraft Co. Ltd.	10	0	0
Mr. Oswald Short	10	10	0
D. Napier and Son, Ltd.	52	10	0
Gloster Aircraft Co., Ltd.	10	0	0
Bristol Aeroplane Co., Ltd.	25	0	0
Messrs. Saunders-Roe, Ltd.	10	10	0

Gifts of Photographs and Slides

The Council wish gratefully to acknowledge a gift of nine slides from Mr. J. N. Richmond.

From Imperial Airways, a set of photographs of Imperial Airway machines and of Croydon Aerodrome.

From Mr. Tilghman Richards, further photographs of early pre-war aircraft.

From the Bristol Aeroplane Company, a collection of photographs of Bristol aeroplane engine. These photographs are in addition to the collection of seventy-six recently given to the Society by the same firm.

From Mr. F. P. Walsh, an album of photographs of the Heliopolis Meeting of 1910.

From Mr. N. Comper, a number of photographs.

From Mr. Hansell, a Student Member, a number of slides.

From Messrs. Rolls-Royce, Ltd., 23 slides showing various types of Rolls-Royce aero engines.

From Lieut.-Colonel W. Lockwood Marsh, a representative collection of aircraft photographs of the War period, 1914-1918. Lieut.-Colonel Marsh's collection contains very full details of each machine.

From the Gloucester Aircraft Company, Ltd., a collection of photographs of their machines and forms of construction.

From the Bristol Aeroplane Company, a collection of seventy-six photographs of Bristol aeroplanes.

From the H. G. Hawker Engineering Co., Ltd., photographs of Sopwith and Hawker machines.

From Mr. M. H. Volk, a remarkable collection of early photographs of pre-war aircraft.

From Mr. M. L. Bramson, photographs of the Redrup engine.

From Mr. Tilghman Richards, a very full collection of photographs of early pre-war aircraft.

From Mr. C. T. Carr, a large framed photograph of the late Sir MacKenzie Chalmers, a copy of a painting by Mr. T. Martine-Ronaldson.

From Messrs. DeHavilland, photographs of the aircraft of the DeHavilland Company. The photographs are of the DeH. aeroplanes from DeH.1 to the new Moth Three.

From Mr. F. R. B. King, a very interesting photograph of the Willows airship.

From Major D. Lester Gardner, a signed photograph of Mr. Orville Wright. This photograph was one of twelve which Mr. Orville Wright specially signed

and inscribed, " Kitty Hawk, December 17th, 1928," at Kitty Hawk on the 25th anniversary of the first power-driven flight accomplished by man.

From Air Vice-Marshal Sir Sefton Brancker, a framed engraving, dated 1802, of M. Garnerin's balloons. The engraving contains a drawing of M. Garnerin's descent from 8,000 feet in a parachute, " the first ever made in England by a parachute."

From Lieut.-Colonel J. T. C. Moore-Brabazon, six slides of his early flights.

From the Westland Aircraft Works, an album of photographs showing the historical sequence of Westland Aircraft products since the inception of the Aircraft Department of Messrs. Petters, Ltd., in 1915.

Many hundreds of photographs have been received and are now being mounted and indexed with the object of providing an historical collection of photographs of aircraft, heavier and lighter than air, of those who have and are assisting in the development of aircraft, of aircraft engines, parts, and all accessories to aircraft

It is already evident that many photographs will be required to make the collection really representative, and it is earnestly hoped that all members will help to add to the collection in every way they can, not only by sending photographs which are of historical interest, but photographs of present day interest, so keeping the collection up-to-date.

Donations to the Library

The Council gratefully acknowledge the following gifts to the Library:—

From Mr. Villa Gilbert and Mr. F. P. Walsh, a number of old Journals.

The Council always welcome gifts of old Journals as many of these are now completely out of print and it is becoming increasingly difficult to fill in the gaps.

The Council wish gratefully to acknowledge the gift of a number of very interesting postcards and an original programme of the 1911 Circuit of Europe from Captain Howard Reed; and an interesting collection of old air line time tables from Mr. H. R. Trost.

The Council wish to thank Mr. Griffith Brewer for a bound copy of " Les Premiers Hommes-Oiseaux, Wilbur et Orville Wright." This was published in Paris in 1909 and contains a complete account of the work and flights of the Brothers Wright in the United States and France up to that date.

The Council wish also to acknowledge the following gifts:—

A small silver model of Sir Hiram Maxim's Flying Machine, also two lantern slides of the Wright Brothers' Engine of 1903, all from the Science Museum.

Books and papers for the Library from Mrs. Ledeboer and from the Society of British Aircraft Constructors, Limited.

The Council wish gratefully to acknowledge from Mr. Patrick Alexander the gift of books, the trail rope of the balloon Majestic (108,000 cubic feet) and a Stringfellow engine. The latter, which developed one-third of a horse-power, won the first prize in 1868 for the lightest steam engine for its power ever made, and is a remarkable piece of construction.

The Council wish to thank the following for gifts of Journals and books to the Library:—Mr. F. W. Hills, for 1929 Journals; Mr. T. Henry Turner, three German air books purchased in Ruhleben Camp; Mr. Douglas M. Ferrier, copy of December, 1928, Journal; Sir Charles Bright for many old Journals; Journals from Air Commodore A. D. Warrington-Morris; Journals and books from Mr. S. Heppolette King; Mr. J. E. Hodgson, " James Sadler, of Oxford, Aeronaut, Chemist, Engineer and Inventor."

Journals from Mr. J. Hooley, A.M.I.Ae.E.; Handbooks and Literature from Messrs. Vickers (Aviation), Limited, Weybridge; Photographs of Miss Amy Johnson and Herr Kronfeld from Messrs. Vaughan and Freeman, Limited;

a file of " Dammerts Aero-Korrespondenz " and " Deutsche Aero-Korrespondenz," 1924-1927, from Messrs. Trost Brothers; from Mr. Bourne, a very interesting paper on Charles Spencer's flying machine, dated 1879, and a letter from John Frederick Bourne, one of the original members of the Society, and a pioneer experimenter with flying models.

Library

On and after Saturday, January 4th, 1930, the Library was open on Saturday afternoons, from 2.30 to 5.30 p.m., to members, and closed on alternate Wednesday afternoons. The experiment of opening the Library on Saturday afternoons has proved very successful, and has enabled many members to make use of it during their only free time.

The Council wish to draw the attention of all members that books may be borrowed by post by members on payment of postage both ways.

Daniel Guggenheim Medal

The following Memorandum was received during the year from Mr. Griffith Brewer, who is the Royal Aeronautical Society's representative on the Daniel Guggenheim Medal Board of Award:—

DANIEL GUGGENHEIM MEDAL FOR AERONAUTICS

AWARDED TO LUDWIG PRANDTL, GOETTINGEN, GERMANY.

" The second Daniel Guggenheim gold medal for notable achievement in aeronautics has just been awarded to Dr. Ludwig Prandtl, Professor at the University of Goettingen, Germany, ' for pioneer and creative work in the theory of aerodynamics.' Dr. Prandtl is one of the world's most eminent authorities on aerodynamics and other sciences underlying the art of aviation. He is also well known as an investigator and teacher of the laws of mechanics, thermodynamics and the flow of fluids, particularly air and other gases.

" Last Fall, Dr. Prandtl travelled eastward from his home city as a delegate to the World Engineering Congress in Japan at the end of October and the beginning of November. He presented an important paper at this congress. After the congress, he crossed the Pacific Ocean to the United States. He stopped at a number of our universities on his homeward journey, beginning with Stanford University and the University of California. He returned home in March, completing the trip around the world.

" Dr. Prandtl visited New York in February and on that occasion was entertained at dinner at the Engineers' Club by a group of forty American engineers. Following the dinner he delivered an address before the Metropolitan Section of the American Society of Mechanical Engineers. Dean George B. Pegram, of Columbia University, presided at the dinner. Dr. Elmer A. Sperry, Past-President of the American Society of Mechanical Engineers and Vice-President of the Daniel Guggenheim Medal Board, introduced Professor Prandtl on the occasion of his address. They had met in Japan.

" Dr. Prandtl was born 4th February, 1875, at Freising, Germany, and attended the technical high school in Munich. He has been Professor at the University of Goettingen since 1904. He has received many honours, among them the Great Gold Medal of the Royal Aeronautical Society of England in 1927 and the Grashof Medal of the Verein Deutscher Ingenieure in 1929. More than any other one man he stands out to-day as distinctly the ' father ' of the present aerodynamic theory. He has written many treatises on subjects related to aviation and is a widely respected authority.

" The members of the Board which made the award are:—*American*: W. D. Durand, E. P. Warner, Elmer A. Sperry, Arthur Nutt, Howard E. Coffin, Paul G. Zimmermann, E. E. Aldrin, Emory S. Land. *Foreign*: Griffith Brewer,

England; Johann Schuette, Germany; Giulio Costanzi, Italy; Baron Chuzaburo Shiba, Japan; Dr. Rateau, of the Societe Francaise de Navigation Aerienne, died before the ballot was cast.

" The first award of the Guggenheim Medal for notable achievement in aeronautics was made to Orville Wright a year ago and the medal was presented to him in Washington on 8th of April in connection with the celebration of the 50th Anniversary of the American Society of Mechanical Engineers. This Society is one of the two American organisations from which members of the Medal Corporation are chosen, the other being the Society of Automotive Engineers. In addition five foreign organisations are represented on the Board of Award, one each in England, France, Germany, Italy and Japan.

" The Medal was founded in 1927 by the Daniel Guggenheim Fund for the Promotion of Aeronautics, of which Mr. Harry F. Guggenheim, now Ambassador to Cuba, was the president. At the annual meeting on 7th May the following officers were elected:—President, William B. Stout, representing the Society of Automotive Engineers, President of the Stout Air Service; Vice-President, Captain E. E. Aldrin, Manager, Aviation Department of the Standard Oil Development Company; Secretary and Treasurer, Alfred D. Flinn, Director of Engineering Foundation; Executive Committee, the President, Captain Aldrin and Mr. E. P. Warner, Editor of ' Aviation '."

Dinner to Lord Wakefield of Hythe

On the occasion of the dinner and dance to Lord Wakefield of Hythe on Thursday, May 15th, the following telegram was received by the President:—

> " I cordially associate myself with the tribute that is being paid by the Royal Aeronautical Society to Lord Wakefield for his outstanding services to British Aviation. They are of National and Imperial value.
>
> ALBERT, *Patron.*"

Contributions to the Journal

In response to inquiries from a number of members the Council will always be glad to consider contributions on any subject dealing with aeronautics or any of its allied subjects. The Council would like to impress upon all members that they should look upon the Journal as the proper place of publication of any original work which they may have done. The Journal circulates all over the world and is recognised to be the most authoritative publication of its kind now printed.

By supporting the Journal in this way members will make the Journal still more influential and will enable it to increase its already wide circulation, and in this way directly benefit the Society as a whole.

Membership Badges

For those members of the Society who wish to have them, a badge has been prepared. The badge shows the symbols of the Society, the peregrine and balloon, in finely chased gilt on a blue enamel background, surrounded by a royal blue border on which appears the lettering " Royal Aeronautical Society, 1866." The badges have been hand made with the greatest care so that they will always retain their original appearance, and it is hoped that members will wear them on all suitable occasions. The price is 5/-, or 5/3 post free.

Correction

The lecture on " Wireless Apparatus for Aircraft," printed in the last number of the Journal, should be by Mr. C. B. Carr, and not C. B. Cave.

LIBRARY ADDITIONS, 1930

MISCELLANEOUS

This Bondage, B. Acworth.
The Modern Warship, E. L. Attwood.
An Approach to Winged Flight, J. D. Batten.
High Speed Propulsion for Aircraft, E. W. Brackenbury.
Transport Aviation, A. Black.
The Volatility of Motor Fuels, G. G. Brown.
The Air Annual of the British Empire, 1930, Edited by Sq.-Ldr. C. G. Burge.
The World, the Air, and the Future, Sir Dennistoun Burney.
Steam and Gas Engineering, T. E. Butterfield.
Amy Johnson, Lone Girl Flyer, C. Dixon.
Parachutes for Airmen, C. Dixon.
Parachuting, C. Dixon.
Stunt Flying, Capt. R. Duncan.
Physical Map of the Arctic, L. Ellsworth.
Gliding and Motorless Flight, L. Howard Flanders and C. F. Carr.
International Aero Exhibition, 1929.
An Historical Survey of Italian Aeronautics, R. Giacomelli.
Les machines volantes de Leonard de Vinci et le vol à voile, R. Giacomelli.
The Seven Skies, H. F. Guggenheim.
The Romance of a Modern Airway, H. Harper.
Airplane Mechanics Rigging Handbook, R. S. Hartz and E. E. Hall.
A Complete Course in Practical Flying, Col. G. L. P. Henderson.
Handbuch fur den Flugzeugbau, Fritz Hohm.
Ordeal by Air, S. Scott Hughes.
The Work of the Byrd Antarctic Expedition, 1928-1930, W. L. G. Joerg.
Simplified Aerodynamics, A. Klemin.
Von den Gefahren des Luftmeeres, H. Koppe.
Magneto Manual, H. R. Langman.
Aviation Year Book, C. E. Lee.
Pilot's "A" Licence, Fourth Edition, J. F. Leeming.
The Air Traveller's Guide to Europe, Capt. N. Macmillan.
Parachute, C. J. V. Murphy.
Air Pioneering in the Arctic (The Two Polar Flights of Amundsen and Ellsworth), National Americana Society.
Airplane Structures, A. S. Niles and A. J. Newell.
The Law of Aviation, G. D. Nokes and A. P. Bridges.
The A.B.C. of Aviation, V. Page.
Aviation Engines, V. Page.
How to Become an Air Pilot, R. L. Preston.
The Earth for Sam, W. Maxwell Reed.
Der Rote Kampfflieger, Rittmeister M. F. von Richthofen.
Imperial Air Routes, Major A. E. W. Salt.
Die Rakete fur Fahrt und Flug, A. B. Schevechevsky.
Hydro und Aero Dynamik, Schiller.
Aerodynamik des Fluges, H. Schmidt.
Verhandlungen des Magnetischen und Meteorologischen Observatoriums zu Irkutsk, W. B. Schostakowitsch.
Flying Pioneers, Hammondsport, 1904-1914, L. J. Seely.
Air Power and the Cities, J. M. Spaight.
The Broad Skyway, M. Steuart.
Aircraft Instruments, C. J. Stewart.
Zweideutsche Luftschiffhafen des Weltfrieges Ahlhorn Wildeshauten, Dr. F. Strahlmann.
How to Fly, Barrett Studley.
Sturme u Luftsiege, Ritter von Tut Tutschek.
Continuous Flow round Streamline Bodies with potential of velocity, Parts II. and III., IV. V., A. van der Vliet.
La Navigation Aerienne Transatlantique, G. Voitoux.
Les Premiers Hommes-Oiseaux, W. and O. Wright.
Etude et Perfectionnement du Compas Magnetique a Induction, G. Y. Zara.
The Aerofield, April, 1926, to Nov. (except Aug.), 1926, and Jan., 1927.
British Official Catalogue Ghent Exhibition, 1913.
Nuove formole relative al compart amento adiabatico del gas negli aerostati, M. Panetti.
Prove sperimentali sui tubi di accompagnamento delle scie d'elica.
Prove Sulla resistenza obliqua dell'aria a velocita balistiche a quella del suono.
La determinazione sperimentale dei campi aerodinamici a due ed a tre dimensioni per mezzo della vasca elettrica, C. Ferrari.
"Dammerts Aero-Korrespondenz," 1924-1927.
Extract from "The Times" and others about Charles Spencer's Patent Flying Machine; and letter written by Mr. C. Spencer.
Seven Russian Pamphlets on Airships, A. Woroflieff.
Proceedings of the Institution of Automobile Engineers, 1929–1930, Vol. XXXV.
Transactions of the Chartered Institute of Patent Agents, Vol. XLVIII.
Transactions of the Inst. of Engineers, Australia, Vol. VIII., 1927.
Transactions of the Inst. of Engineers and Shipbuilders in Scotland, Vol. LXXII., 1928-1929.
Proceedings of the Institution of Mechanical Engineers, 1929, Vol. II.
Journal of the Institute of Metals, Vol. XLII., No. 2; Vol. XLIII., No. 1.
Transactions of the Inst. of Naval Architects, 1929.
Proceedings of the Royal Society of Edinburgh, Vol. XLIX. and Vol. L.

Proceedings of the International Mathematical Congress, 1924, Vol. I. and II.

Abstracts of the Papers to be read at the World Engineering Congress, Tokyo, 1929.

World Engineering Congress, Tokyo, 1929.
Official Bulletins, Oct. 28 to Nov. 9.
Official Programme.
Programme of Sectional Meetings.
Author's Index.

Wrought Alloys of Aluminium in Aircraft, British Aluminium Company, Limited.

Modern Steelwork, British Steelwork Association.

Carnegie United Kingdom Trust.
12th Annual Report.
13th Annual Report.
14th Annual Report.

Carnegie United Kingdom Trust 16th Annual Report.

The Daniel Guggenheim International Safe Aircraft Competition, Final Report.

Daniel Guggenheim Fund.
Equipment used in Experiments to Solve the Problem of Fog Flying.

The Industrial Arts Index, 1928-1929.

The Industrial Arts Index, 1929-1930.

Standard Specifications for Benzole and Allied Products, 1929, Nat. Benzole Assoc.

Report of the National Physical Laboratory for the Year 1929.

L'Année Aéronautique, 1929-1930, L. Hirschauer and C. Dollfus.

Ergebnisse der Aerodynamischen Versuchsanstalt zu Gottingen 11 lieferung.

Jahrbuch der Wissenschaftlichen Gesellschaft fur Luftfahrt, 1929.

The Journal and Transactions of the Harbin Polytechnic Institute, Manchuria, China.

Smithsonian Reprints.
The Radiation of the Planet Earth to Space, G. G. Abbot.
The Past Climate of the North Polar Region, E. W. Berry.
The Atmosphere and the Sun, H. Helm Cayton.
Geochronology as based on Solar Radiation and its relations to Archeology, G. de Geer.
New Results on Cosmic Rays, R. A. Millikan, G. H. Cameron.
Three Centuries of Natural Philosophy, W. F. G. Swann.

Report of the New York State Commission on Aviation.

State Aeronautical Legislation and Complication of State Lews, U.S. Dept. of Commerce.

A Report on American Museum Work, E. E. Lowe.

A Report on the Public Museums of the British Isles, Sir Henry Miers.

Department of National Defence, Canada.
Reports on Civil Aviation for 1928 and 1929.

University of Toronto.
Biological Series No. 33, J. R. Dymond.
Publications of the Ontario Fisheries, J. L. Hart.
Res. Laboratory, A. L. Pritchard.

AERONAUTICAL RESEARCH COMMITTEE

Report for the Year 1929-1930.

Technical Report for 1928-1929, Vols. I. & II.

R. & M. No. 1199.
Skin Friction and the Drag of Streamline Bodies, B. M. Jones.

R. & M. No. 1203.
Pressure Distribution over a Yawed Aerofoil, D. H. Williams.

R. & M. No. 1207.
Wing Flutter as Influenced by the Mobility of the Fuselage, R. A. Frazer, W. J. Duncan.

R. & M. No. 1217.
Conditions for the prevention of flexural-torsional flutter of an elastic wing, R. A. Frazer, W. J. Duncan.

R. & M. No. 1220.
Age-Hardening of some Aluminium Alloys, M. L. V. Gayler, G. D. Preston.

R. & M. No. 1222.
High Frequency Fatigue, G. D. Lehmann, C. F. Jenkin.

R. & M. No. 1224.
On the Flow of Air adjacent to the Surface of an Aerofoil, N. A. V. Piercy, E. G. Richardson.

R. & M. No. 1227.
The Wing Flutter of Biplanes, W. J. Duncan.

R. & M. No. 1228.
Full-Scale Control Tests on Fokker F.VII. 3M Monoplane, J. K. Hardy.

R. & M. No. 1229.
Loads on the Main Planes and Tails of an Aeroplane when recovering from a Dive, H. Bolas, G. A. Allward.

R. & M. No. 1230.
Pressure Plotting with a Streamline Body with Tractor Airscrew running, C. N. H. Lock, F. C. Johansen.

R. & M. No. 1233.
The Graphical and Analytical Determination of Stresses in Single Span and Continuous Beams under End Compression and Lateral Load with Variations in Shear, Distributed Load and Moment of Inertia, H. B. Howard.

R. & M. No. 1234.
Tests on Airship Models at large Reynolds Numbers, L. F. G. Simmons.

R. & M. No. 1235.
On the Stability of Controlled Motion, W. L. Cowley.

R. & M. No. 1237.
The Flutter of Aeroplane Tails, R. A. Frazer.

R. & M. No. 1238.
Effect of Body Interference on the Efficiency of an Airscrew, C. N. H. Lock.

R. & M. No. 1239.
Application of the Theoretical Velocity Field round a Spheroid to calculate the Performance of an Airscrew near the Nose of a Streamline Body, C. N. H. Lock.

R. & M. No. 1241.
Experiments on a Series of Symmetrical Joukowski Sections, A. Fage, V. M. Falkner, W. S. Walker.

R. & M. No. 1242.
The Force and Moment on an Oscillating Aerofoil, H. Glauert.

R. & M. No. 1243.
Wind Tunnel Tests on a Symmetrical Aerofoil (Göttingen 429 Section), W. G. A. Perring.

R. & M. No. 1244.
The Influence of Oxygen on Corrosion Fatigue, A. M. Binnei.

R. & M. No. 1245.
Fuel flow Meters designed to measure Mass Flow, P. S. Kerr.

R. & M. No. 1248.
Torsional Vibration of Crankshafts. A description of the R.A.E. Staff of the MK III. Torsiograph, R.A.E.

R. & M. No. 1250.
List of Reports and Memoranda of the Aeronautical Research Committee published between 1st Aug., 1928, and 31st Aug., 1929, A.R.C.

R. & M. No. 1251.
Some Early Model Experiments on Devices for Improving Lateral Control near the Stall, H. B. Irving and A. S. Bateson.

R. & M. No. 1252.
Flow through pipe orifices at low Reynolds Numbers, F. C. Johansen.

R. & M. No. 1254.
Part I.—A method of Calculating Suitable Airscrew Characteristics to meet given Airscrew Performance.
Part II.—A Comparison of the Observed Change of Performance Consequent on a Change of Airscrew and the Change Predicted by the Methods of Part I., R. S. Capon.

R. & M. No. 1256.
The Distribution of Pressure over a Section of an Airscrew Blade in Flight, and the Variation of Lift Coefficient with the Speed of the Section, E. T. Jones.

R. & M. No. 1258.
Notes on the Flutter of Airscrew Blades, E. Lynam.

R. & M. No. 1259.
Theoretical Relationship for a Wing with Unbalanced Ailerons, A. S. Hartshorn.

R. & M. No. 1263.
Full-Scale Determination of the Motion of an Avro Aeroplane when Stalled, K. W. Clark, W. G. Jennings.

R. & M. No. 1265.
Engine Performance with Gaseous Fuels, W. Helmore.

R. & M. No. 1266.
Experiments of Flame Extinction in Gaseous Mixtures, S/L. W. Helmore.

R. & M. No. 1267.
Reduction of Drag of Radial Engines by the Attachment of Rings of Aerofoil Section, including Interference Experiments of an Allied Nature, with some Further Applications, H. C. H. Townend.

R. & M. No. 1268.
Experiments relating to the flow in the boundary layer of an airship model, L. F. G. Simmons

R. & M. No. 1269.
Full-Scale Maximum Lift Coefficient of R.A.F. 28 Section Wing, E. T. Jones, K. W. Clark.

R. & M. No. 1270.
The Full-Scale Determination of the Lateral Resistance Derivatives of the Bristol Fighter Aeroplane. Part III. The Determination of the Rate of Roll Derivatives, E. T. Jones.

R. & M. No. 1271.
Investigation of the Boundary Layers and the Drags of Two Streamline Bodies, C. T. Hutton, E. Ower.

R. & M. No. 1272.
Wing Tunnel Tests with High Tip Speed Airscrews. Experimental Investigation of Blade Twist under Load, G. P. Douglas, W. G. A. Perring, R. A. Fairthorne.

R. & M. No. 1273.
Experiments on an Ape Aeroplane fitted with Pilot Planes, S. Scott-Hall.

R. & M. No. 1274.
Stresses and Strains in Airscrews with particular reference to Twist, R. McKinnon Wood.

R. & M. No. 1275.
The Interference of a Wind Tunnel on a Symmetrical Body, C. N. H. Lock.

R. & M. No. 1276.
The effect of span on aircraft performance, W. G. Jennings.

R. & M. No. 1277.
Stability Derivatives of the Bristol Fighter, A. S. Halliday.

R. & M. No. 1279.
Tests under Conditions of Infinite Aspect Ratio of 4 Aerofoils in a High Speed Wind Channel, T. E. Stanton.

R. & M. No. 1280.
On the Distribution of Pressure over a Symmetrical Joukowski Section at High Speeds, T. E. Stanton.

R. & M. No. 1281.
" Cornering " at High Speeds, W. C. Jennings.

R. & M. No. 1282.
Full-Scale Experiments on High Tip Speed Airscrews. Comparative Performance Trials of Three Airscrews of Different Sections, W. G. Jennings.

R. & M. No. 1283.
The Effects of Turbulence and Surface Roughness on the Drag of a Circular Cylinder, A. Fage and J. H. Warsap.

R. & M. No. 1284.
Pressure Plotting a Streamline Body with Tractor Airscrews Running. Part II. Airscrew in Rear Position, F. C. Johansen and C. N. H. Lock.

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Obituary

The Council have to record with deep regret the deaths of many of its members during the year. Those who lost their lives in the R 101 disaster were recorded in the November Journal.

HARRY BOLSOVER, *Associate Member*

Harry Bolsover died as the result of an accident when the City of Washington, in which he was travelling, made a forced landing. He was elected an Associate Member in 1925 and was not only a very keen member of the Society, but a very active member of the Manchester Branch.

Mr. Bolsover was educated at Old Trafford Technical School, and served with the British Westinghouse until he was appointed in charge of engine work, engine testing and installation with Messrs. A. V. Roe, with whom he remained until his death. He had a very considerable flying experience, chiefly on test flights of new machines, and was a very able aeronautical engineer. Harry Bolsover was a very likeable man, popular with those who served with him, and with qualities which it will be difficult to find in another man.

HERBERT GUY FFISKE, *Companion*

Major H. G. ffiske, who died on July 3rd, 1930, had been a member of the Society since 1925.

Major ffiske had been connected with Boulton and Paul, of Norwich, since 1907, being manager of their London office. During the War he served in France, first with the Royal Field Artillery and afterwards with the Royal Flying Corps, subsequently in Mesopotamia and Egypt. He retired with the rank of Major and on demobilisation returned to his duties in London. By the death of Major ffiske the Society has lost one of its most esteemed members.

JOHN HENRY LEDEBOER, *Associate Fellow*

John Henry Ledeboer, who died on February 7th, was born on November 27th, 1883; the son of H. A. Ledeboer, of Manchester. He was educated at Tonbridge and Caius College, Cambridge, of which college he was a scholar. He took a first class in the Medieval and Modern Languages Tripos. From his earliest years he took a keen interest in aviation and on coming down from Cambridge he founded and edited "Aeronautics," of which he was editor from 1907 to 1916. In its pages appeared many important technical articles on aviation, and under Mr. Ledeboer's editorship the paper became an important publication devoted to technical questions.

During the war he rose to be a Major in the R.A.F. and continued to serve until shortly before his death. He became an Associate Fellow in 1908, and was the author or co-author of a number of books on aviation, and numerous technical and other contributions to various papers.

Major Ledeboer was widely known and liked. He was a man of great brilliance and by his early death aviation has lost one who had a wide grasp and an enviable knowledge of British aircraft, one who, as far back as 1906, foresaw that the world of the future was in the air.

PANDIA ANTONIO RALLI, *Associate Fellow*

Mr P. A. Ralli, who died in a nursing home at the early age of 41, was an Associate Fellow of the Society.

Mr Ralli, who had been ill for some months, was one of the most brilliant scientific men in aviation, and his death will leave a gap which will be difficult to fill. Educated at Lausanne as an electrical engineer, with a wide knowledge

of mathematics and physics, Mr. Ralli joined the technical staff of the Fairey Aviation Company in 1916.

From the beginning of his work there his outstanding ability was recognised. He carried out original research on the strength and performance of high-speed and high performance aircraft, which proved of the utmost value. He made a special study of the problems connected with airscrews, and it was largely due to his work that the Schneider Trophy was won from Italy in 1927 and retained in 1929. For his work on airscrew design he was awarded, in 1928, the Silver Medal of the Society.

All those who worked under Mr. Ralli, who was head of the Technical Department at Messrs. Fairey's, found his advice and experience placed ungrudgingly at their disposal. Their loss is a loss to aviation as a whole of a man of great personal charm and ability.

Henry O'Neil de Hane Segrave, *Associate*

Major Sir Henry Segrave, who was only elected an Associate of the Society in May, was killed on Lake Windermere on 13th June through the capsizing of the motor-boat Miss England II.

Born on 22nd September, 1896, Sir Henry was educated at Eton and Sandhurst. During the War he served in the 2nd Warwickshire Regiment and then in the Royal Flying Corps. After much service he became disabled as the result of a crash and was posted to the War Office in 1917, and in May, 1918, was appointed Technical Secretary to the Minister for Air. He went to Washington with the British Aviation Mission in the same year.

After the War Sir Henry turned his attention to motor-car racing, and first achieved international fame in 1923 by winning the Grand Prix de France. He won many other important Continental races during the next few years, and achieved several successes at Brooklands. At Daytona Beach, Florida, in 1926, Sir Henry achieved a world record motor-car speed of 203.988 m.p.h., and his last and greatest triumph in road racing was in March, 1929, when he broke the world record at Daytona in the "Golden Arrow" at an average speed of 231.36 m.p.h.

Sir Henry then turned his attention to obtaining the water-speed record for Great Britain, in the achievement of which he met his death.

Captain Charles Sutton, *Associate Member*

Captain Charles Sutton, who was killed in a flying accident to the seaplane he was piloting at Toronto in September, was born on August 7th, 1894. Educated at Clacton, he joined C. A. Vandervell's and received training in machine-shop work and particularly electrical work.

He joined the R.F.C. in 1916, and took various engine courses, as well as the pilot's course at the Central Flying School. Captain Sutton had a wide experience of various types of aircraft, from the early Maurice Farman's to the latest type of post-war aircraft. After service on the Western Front he was drafted home in command of detached flights against air raiders. After the War he saw service in Iraq, Egypt and the Sudan, until 1926 when he went to Canada and took part in air survey exploration work. He had some 2,000 solo flying hours to his credit and an experience of flying under all conditions which has been given to comparatively few. Captain Sutton became an Associate Member of the Society in 1926, and was keenly interested in its work. An enthusiast in all he did he will be missed by all those who knew him well, and knew how much his heart was in aviation.

REVIEWS

Henley's ABC of Gliding and Sailflying

Edited by Major Victor W. Page. (The Norman W. Henley Publishing Co., New York.) Price $2.

The name of the author, or authors, is not stated, and after reading through the book this omission appears wise, although Victor W. Page is the editor.

The lay-out of the volume is somewhat haphazard. Chapter V is devoted to " The formation of clubs " and is sandwiched between chapters dealing with " Typical soaring planes " and " Descriptions of modern sailplanes."

Actually a slight knowledge of gliding and sailplaning is displayed together with a large amount of ignorance and this has been puffed out so as to occupy over 280 pages.

The whole book suffers badly from duplication and complication, confusion and contradiction. Dealing with the training of beginners it is stated, on page 162, that " As the pilot shows progress he is allowed to take the ship further up the slope." Three pages later we read, " The *length* of the jumps *are* gradually increased, the student starting at the base of a hill and progressing upward to the crest," and to impress this more firmly, or to help fill the book, we read once again, two pages further on, " One of the most important things is that a beginner must be started below the top of the slope."

Again, on page 183, " The shape of the ribs which serve to take up and transmit the air pressure forces to the beams is determined by the profile "; while on page 185, " The ribs receive the air *pressure* and transmit *them* to the spars. Their shape is determined by the wing profile."

Chapter I gives a brief history of gliding from the earliest days, and even here the same lack of proportion is shown by including a sketch giving the method of carrying a " Zogling " to the top of a hill amongst sketches of historical machines. Incidentally, people are seen carrying the glider by the trailing edge of the main plane and the tail plane tips.

Technical terms are abused and slang is common throughout. Instances are " Aspect ratio of better than 6 to 7 "; elevators are called " tail flappers "; and " the lift-drag ratio is greatest when the lift force is high and the drag force is low."

The matter on aerodynamics is generally wrong or misleading and includes a diagram of the airflow past an aerofoil in which the air above completely leaves the top surface, rises to a height of about quarter chord, and descends again at the trailing edge, while the airflow below the wing is completely unaltered. Page 31 suggests that " if an object moves through the air instead of air flowing past the object the air pressures would be changed, thus limiting the value of the table."

A paragraph on page 25 is headed, " Air has weight," but no explanation of this is offered in what follows; while on page 39, under the heading " How gliders are supported in air," it is stated that " the action of a glider and the way sustentation is obtained *is* different from that of an aeroplane." The case of an aeroplane is then given incorrectly and of a glider not at all.

Sustained flights are dealt with vaguely in a few lines; seven-year-old types are given as typical sailplanes " as it is difficult to see how they can be improved in the light of our present aerodynamical knowledge "; and airworthiness regulations are given in full for light-powered aircraft only.

The diagrams of airflow past hills on page 34 and in other places are completely wrong, as the flow is shown to remain exactly horizontal until it

reaches the side of a hill, here most of it disappears while some flows up and over the top after which it retains its height in another horizontal stream. Leeward eddies exist, but none on the windward side.

Finally, the height record is apparently held by Schulz, 2,566 feet, while the distance record stands at 42 miles. The flights of Kronfeld during the last three years, in which distances of 100 miles have been covered and a height of about 7,000 feet obtained, are not mentioned although the book is written in 1930.

There may be a demand at present for good books dealing with gliding and soaring, but certainly this is not the sort that will help the movement and it will be a pity if the demand is abused by a flood of journalistic rubbish.

Parachuting

Charles Dixon. (Sampson Low.) 12s. 6d. net.

Amy Johnson—Lone Girl Flyer

Charles Dixon. (Sampson Low.) 3s. 6d. net.

Parachute

Charles J. V. Murphy. (Messrs. Putnam.) 10s. 6d. net.

Mr. Charles Dixon describes himself as an ex-observer, Royal Naval Air Service and Royal Air Force. If he continues to produce books at the rate he does he will undoubtedly be described as an aerial Edgar Wallace, and will suffer all the latter must from literary high-brows. One rather fancies that Mr. Charles Dixon believes in taking the cash and letting the credit go. Certainly neither of these two books will add to his credit in aviation circles. Mr. Dixon has yet to learn that easy writing is cursed hard reading.

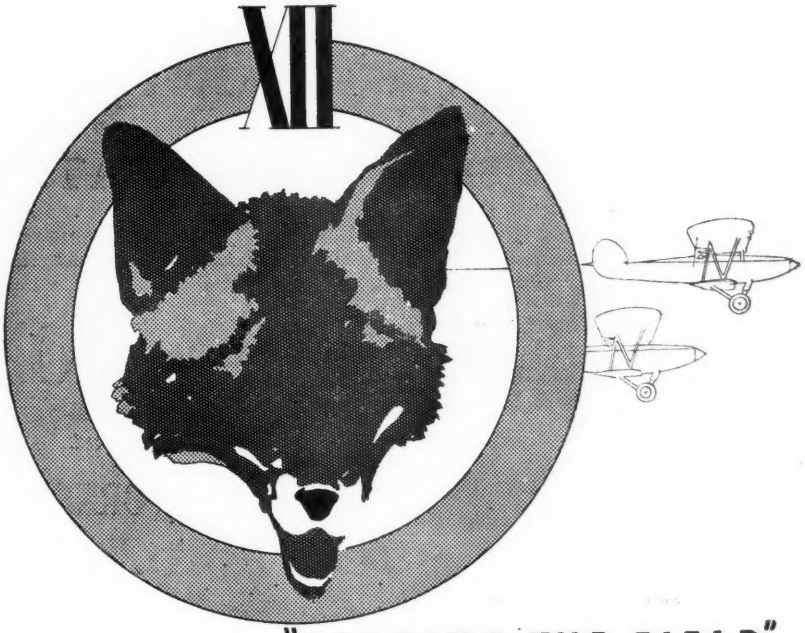
" One of the most intense struggles to escape from a crashing aeroplane befel a noted Royal Air Force pilot, Flight Lieutenant S. L. G. Pope, A.F.C., . . . and so Pope, a magnificent specimen of a man, was selected to essay the second vital test."

The aircraft Pope was testing broke its tail plane and after the " intense struggle," he landed " in sheer astonishment at the obvious fact he was still alive. And how enjoyable life felt to him as, a moment later, he was able to run across the fields to inspect his crashed fighter."

The book is written largely in superlatives, and badly chosen at that, and will do little to advance the cause of the parachute.

Miss Amy Johnson's fine achievement in flying to Australia brought her an unfortunate publicity which will not be made any better by Mr. Charles Dixon's book, compiled so largely from newspaper cuttings and filled with so much matter entirely irrelevant to the flight.

The book by Mr. Charles J. V. Murphy is no better than the previous two The historical part is scrappy and the remainder a boost for American parachuting exploits. A quotation will show the method. " The United States, with traditional push and resourcefulness, grabbed up the half-developed parachute at the close of the War and carried it towards its present perfection." The book is clearly a veiled advertisement for one particular type of parachute. The actual writing is appalling.



"LEADING THE FIELD"

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Camera Obscura Exercise—Best bombing average.

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Brooke-Popham-Steel Shooting Cup for the best Squadron Rifle Team—Won by No. 12 Squadron at Bisley, June, 1930.

Armament Officers' Bombing Trophy—First holders and the Squadron top of the Day Bombers for the third year in succession."

Extract. "The Aeroplane," October 15th, 1930

No. 12 Squadron is equipped with Fairey "Fox" high performance day-Bomber aircraft.

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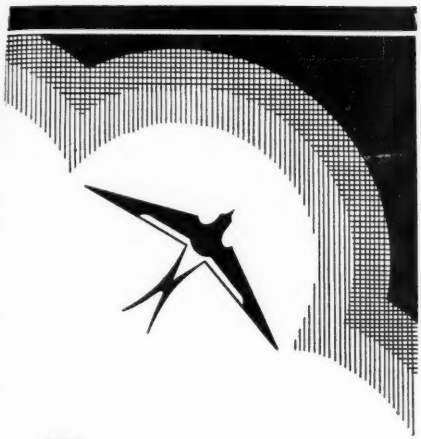

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The Institution of Mechanical Engineers
The Institution of Electrical Engineers
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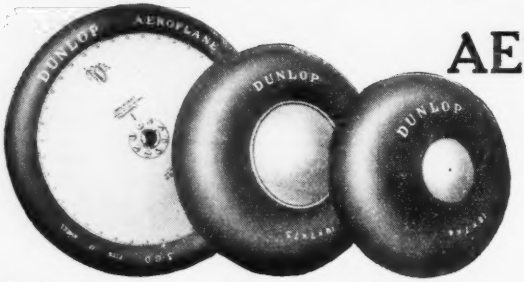

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The range of Dunlop wheel-less tyres has now been increased and wheel-less equipment has been developed in all the popular sizes. This equipment eliminates wheel structure entirely and provides tyres which can be used with extremely low inflation pressure giving maximum cushioning effect and easier riding over soft or rough landing surfaces.

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THE
ROYAL AERONAUTICAL SOCIETY
With which is incorporated the Institution of Aeronautical Engineers

MONTHLY NOTICES
JANUARY, 1930

The Aeronautical Diary

The Aeronautical Diary for 1930 has just been published by Messrs. Gale and Polden. For those who are members of the Society, the diary is obtainable with the Society's crest on it in gold. The diary contains very full information of aeronautical bodies, flying clubs, civil flying schools, aircraft and aero engine manufacturers, commercial and light aircraft, aero engines, notes on licensing private pilots, air touring facilities, air stations, air records and aircraft making, as well as tables and other information of interest to airmen, forthcoming lectures, etc. It is hoped that every member of the Society will buy a copy of the diary, the first one of its kind for those interested in the progress of civil aviation, for it is not only the most useful diary extant for pilots and aeronautical engineers, but by buying it every member is directly helping the Society. A percentage of the profits from all copies sold is being given by the publishers to the Endowment Fund. The prices of the diary are as follows:—Bound in blue cloth, without loop and pencil, 1s. 6d. net; in blue cloth, with loop and pencil, 2s. net; in royal blue leather, with loop and pencil, 3s. net; in refill form in solid blue morocco leather wallets, 7s. 6d.

Library

The attention of all members is drawn to the new hours of opening the Library which come into force in 1930.

On and after Saturday, January 4th, 1930, the Library will be open on Saturday afternoons from 2.30 p.m. to 5.30 p.m. to members. It will be closed on alternate Wednesday afternoons. The complete times of the opening of the Library are as follows:—

Monday—Friday, 9.30 a.m.—5 p.m., except alternate Wednesday afternoons, 2 p.m.—5 p.m.

Saturday, 9.30 a.m.—12.30 p.m., 2.30 p.m.—5.30 p.m.

Council Meeting

A meeting of Council was held on Tuesday, December 10th, 1929, at 7, Albemarle Street, W.1.

Present: Colonel the Master of Sempill (*President*), in the chair.
Mr. Griffith Brewer.
Major D. H. Kennedy (*Hon. Treasurer*).
Captain A. G. Lamplugh.
Major R. H. Mayo.
Mr. W. O. Manning.
Lieut.-Colonel J. T. C. Moore-Brabazon (*Vice-President*).
Mr. H. E. Wimperis (*Vice-President*).
Mr. L. A. Wingfield (*Hon. Solicitor*).

Among the business under consideration was the following:—A statement by Major Mayo on his return from the United States of America to witness the trials for the Guggenheim Safe Aircraft Competition; Major Mayo was specially thanked by the Council for his efforts in securing a grant of $10,000 to the Society from the Guggenheim Fund for the Promotion of Aeronautics; the award of the silver medal; receipt of acceptances to the Education and Examinations Committee; the report of the Finance Committee; and the report of the Grading Committee.

Elections

At a meeting of Council held on Tuesday, December 10th, 1929, the following recommendations of the Grading Committee were approved:—

Associate Fellows.—William George Gould, Aubrey Lawrence Lingard.

Associate Member.—Harry Thomas Tremelling.

Associate.—Harold Vernon Whiting.

Students.—Albert Horace Brett, Reginald Ernest Collins, Ernest Folley, Francis Leslie Hales, William George Hilldrop, Arthur Leslie Holland, Ernest Herbert Lanham, Edward Charles Smith-Ross, Arthur Braybrooke Stutter, Alan Alfred Tier.

Companion.—Percival Phillips.

Education and Examinations Committee

An Education and Examinations Committee has been appointed by the Council to explore the situation with regard to aeronautical engineering education. The Council are of the opinion that the time has now come when education facilities in all branches of aeronautics should be extended and schemes and syllabuses drawn up, if possible, for that purpose. The Committee is as follows:—

Chairman: Mr. H. T. Tizard, F.R.Ae.S.
Professor L. Bairstow, F.R.Ae.S.
Major T. M. Barlow, M.Inst.C.E., M.I.Mech.E., F.R.Ae.S.
Captain F. T. Hill, F.R.Ae.S., M.I.Ae.E.
Professor B. Melvill Jones, F.R.Ae.S.
Mr. Page (Chief Education Adviser, Air Ministry).
Dr. N. A. V. Piercy, F.R.Ae.S.
Captain G. S. Wilkinson, F.R.Ae.S.

The first sitting of the Committee will be held towards the end of the present month.

Gifts of Photographs

The Council wish gratefully to acknowledge the gift of the following photographs to the Society:—

From Lieut.-Colonel W. Lockwood Marsh, a representative collection of aircraft photographs of the War period, 1914-1918. Lieut.-Colonel Marsh's collection contains very full details of each machine.

From the Gloucester Aircraft Company, Ltd., a collection of photographs of their machines and forms of construction.

From the Bristol Aeroplane Company, a collection of seventy-six photographs of Bristol aeroplanes.

From the H. G. Hawker Engineering Co., Ltd., photographs of Sopwith and Hawker machines.

From Mr. M. H. Volk, a remarkable collection of early photographs of pre-war aircraft.

From Mr. M. L. Bramson, photographs of the Redrup engine.

Srom Mr. Tilghman Richards, a very full collection of photographs of early pre-war aircraft.

The Council also wish to acknowledge a large photograph from Mr. C. T. Carr of the late Sir MacKenzie Chalmers, a copy of a painting by Mr. T. Martine-Ronaldson.

Largely due to the generous response of members of the Society and of firms, the Society's collection of photographs is rapidly increasing. The Council are very anxious to make the Society's collection of aircraft subjects as complete as possible. There are many gaps and it is hoped that every member will assist, as far as possible, to fill them. Photographs are particularly wanted of aircraft and aircraft parts (including airships), engines, personalities, etc., covering the period 1906-1918.

Journal Binding

Members are reminded that if they send a remittance of 4s. 6d. for the 1929 volume, and 5s. od. for former volumes, to this office, and send their Journals, with their name and address, to the Lewes Press, Ltd., High Street, Lewes, Sussex, the Journals will be bound and returned to them, post free.

Subscriptions

Members are reminded that their subscriptions for 1930 became due on January 1st.

Side-slip Indicator

A member wishes to get in touch with another member who would carry out a flying test with a new positive side-slip indicator and semi-automatic control for flying tuition purposes. Will any member willing to carry out such a test communicate with the Secretary?

Forthcoming Events

Thursday, January 9th.—Lecture by Mr. Mackinnon Wood, "The New American Wind Tunnels," at **6.30** p.m., in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2.

Thursday, January 16th.—Lecture before Yeovil Branch, "Wireless Apparatus for Aircraft," by a representative of Marconi Wireless Co., Ltd.

Thursday, January 23rd.—Lecture before Yeovil Branch, "Wapiti Steel Wing Construction," by Mr. Brian L. Martin, B.Sc., A.F.R.Ae.S.

Thursday, January 23rd.—Lecture by Mr. H. B. Howard, "Airworthiness Certificates," at 6.30 p.m., in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2.

J. LAURENCE PRITCHARD, *Secretary.*

THE

ROYAL AERONAUTICAL SOCIETY

With which is incorporated the Institution of Aeronautical Engineers

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MONTHLY NOTICES

FEBRUARY 1930

The Aeronautical Diary

The Aeronautical Diary for 1930 has just been published by Messrs. Gale and Polden. For those who are members of the Society, the diary is obtainable with the Society's crest on it in gold. The diary contains very full information of aeronautical bodies, flying clubs, civil flying schools, aircraft and aero engine manufacturers, commercial and light aircraft, aero engines, notes on licensing private pilots, air touring facilities, air stations, air records and aircraft making, as well as tables and other information of interest to airmen, forthcoming lectures, etc. It is hoped that every member of the Society will buy a copy of the diary, the first one of its kind for those interested in the progress of civil aviation, for it is not only the most useful diary extant for pilots and aeronautical engineers, but by buying it every member is directly helping the Society. A percentage of the profits from all copies sold is being given by the publishers to the Endowment Fund. The prices of the diary are as follows:—Bound in blue cloth, without loop and pencil, 1s. 6d. net; in blue cloth, with loop and pencil, 2s. net; in royal blue leather, with loop and pencil, 3s. net; in refill form in solid blue morocco leather wallets, 7s. 6d.

Applications for the Aeronautical Diary should be made direct to Messrs. Gale and Polden, Aldershot, and not to the offices of the Society.

Library

The attention of all members is drawn to the new hours of opening the Library which came into force in 1930.

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Saturday, 9.30 a.m.—12.30 p.m., 2.30 p.m.—5.30 p.m.

Library

The Council wish gratefully to acknowledge the generous gift of a number of old JOURNALS from Mr. Villa Gilbert and Mr. F. P. Walsh. Many of the JOURNALS are now out of print, and it is hoped that those members who have duplicate copies, or copies they do not wish to keep, will send them to the Society, so that the files may be completed.

Council Meeting

A Meeting of Council was held on Tuesday, January 14th, 1930, at the offices of the Society. Present:—

Colonel the Master of Sempill, President, in the chair.

Major T. M. Barlow.	Major A R. Low.
Mr. Griffith Brewer.	Major R. H. Mayo.
Major J. S. Buchanan.	Mr. W. O. Manning.
Mr. M. L. Bramson.	Mr. Handley Page.
Captain F. T. Hill.	Air Vice-Marshal Sir Vyell Vyvyan.
Major D. H. Kennedy.	Mr. L. A. Wingfield.
Captain A. G. Lamplugh.	Mr. McKinnon Wood.

Among the business considered was the following:—Fixing of a scale of fees for aeronautical engineering consultants; the report of the Finance Committee; the report of the Grading Committee; the appointment of a representative on Lloyd's Aviation Committee; the arrangements for lectures by Dr. Georgii and Professor Nansen; the award of the Usborne Memorial Prize; the appointment of delegates to the 50th anniversary celebrations in New York of the American Society of Mechanical Engineers.

Elections

At a meeting of Council held on Tuesday, January 14th, 1930, the following recommendations of the Grading Committee were approved:—

Associate Fellows.—Walter Browning, Harry Richard Barnes Fitch, William Helmore, Claude Percival Thomas Lipscombe, A. E. Marsden (re-elected), Aldolf Camden Pratt (re-elected), Walter H. Stamford (re-elected), Hubert Charles Henry Townend, Stephen Cecil Woodward.

Associate.—Cyril Turner.

Students.—Calvert Armstrong, Arthur John Cowderoy, Robert Baines Holmes, Alfred Walter Liquorish, Frederick William McCartney, Richard Philip Wildey Morris, Roy James Nixon.

Companion.—Harold Miller Whitehead.

Lecture on Gliding

The particular attention of all members is drawn to the lecture by Dr. Georgii and Herr Stamer on Wednesday, February 19th, on Gliding in Germany.

The lecture, which will be illustrated by a film of gliding in Germany, will be delivered in the Lecture Hall of the Institution of Electrical Engineers at 6.30 p.m. and *admission will be by ticket only.* In view of the importance of the lecture members who wish to attend should make an early application for tickets as the number will be limited.

Dinner to Dr. Georgii

On the occasion of the visit of Dr. Georgii and Herr Stamer to this country, to lecture on Gliding in Germany, arrangements are being made for holding a dinner (for men only), followed by an informal discussion, at the St. Ermin's Hotel, Caxton Street, Westminster (near St. James' Park Tube Station). The dinner will be held at 7.30 p.m. on Friday, February 21st, 1930, and the cost of tickets will be 6s. 6d. each. Lounge suits will be worn.

The dinner has been arranged in order that all those who are interested in gliding may have a further opportunity of hearing Dr. Georgii and Herr Stamer,

and particularly of asking questions and enabling those present to speak with more freedom than is possible at the more formal lecture.

Members may bring guests to the dinner if they wish. Application for tickets should be made early as accommodation will be strictly limited.

Education and Examinations Committee

An Education and Examinations Committee has been appointed by the Council to explore the situation with regard to aeronautical engineering education. The full Committee is as follows:—

Chairman: Mr. H. T. Tizard, F.R.Ae.S.
Professor L. Bairstow, F.R.Ae.S.
Major T. M. Barlow, M.Inst.C.E., M.I.Mech.E., F.R.Ae.S.
Mr. W. E. Dumbrill, B.Sc., A.R.C.Sc., F.R.Ae.S.
Mr. A. T. E. Eadon.
Captain F. T. Hill, F.R.Ae.S., M.I.Ae.E.
Professor B. Melvill Jones, F.R.Ae.S.
Mr. W. M. Page (Chief Education Adviser, Air Ministry).
Dr. N. A. V. Piercy, F.R.Ae.S.
Captain G. S. Wilkinson, F.R.Ae.S.

Usborne Memorial Prize

The Usborne Memorial Prize for 1929 has been awarded to Mr. S. H. Evans for his paper, entitled "The Cross-Section of the Semi-Rigid Airship."

Donations

The Council wish gratefully to acknowledge from Mr. Patrick Alexander the gift of books, the trail rope of the balloon Majestic (108,000 cubic feet) and a Stringfellow engine. The latter, which developed one-third of a horse-power, won the first prize in 1868 for the lightest steam engine for its power ever made, and is a remarkable piece of construction.

Gifts of Photographs and Slides

The Council wish gratefully to acknowledge a gift of nine slides from Mr. J. N. Richmond.

The Society's collection of slides is now being arranged and indexed by Mr. Howard Flanders. The collection now numbers some 2,000 slides, and it is hoped that any members who have slides of aeronautical subjects will present them to the Society and so make the collection the largest and most representative in the world. These slides may be borrowed by any member for the purposes of giving a lecture.

From Imperial Airways, a set of photographs of Imperial Airway machines and of Croydon Aerodrome.

From Mr. Tilghman Richards, further photographs of early pre-war aircraft.

From the Bristol Aeroplane Company, a collection of photographs of Bristol aeroplane engine. These photographs are in addition to the collection of seventy-six recently given to the Society by the same firm.

From Mr. F. P. Walsh, an album of photographs of the Heliopolis Meeting of 1910.

Largely due to the generous response of members of the Society and firms, the Society's collection of photographs is rapidly increasing. The Council are

very anxious to make the Society's collection of aircraft subjects as complete as possible. There are many gaps and it is hoped that every member will assist, as far as possible, to fill them. Photographs are particularly wanted of aircraft and aircraft parts (including airships), engines, personalities, etc., covering the period 1906-1918.

Fifth International Air Congress

The Fifth International Air Congress will be held at the Hague from the 1st to 6th of September, 1930. The business of the Congress will be divided into five sections:—

A. Aerial Traffic.
B. Science and Technics.
C. Legal Questions.
D. Medical Questions.
E. Aerial Tourism.

The President of the Scientific and Technical Section would appreciate especially the sending of memoranda about:—(1) The separation of the air flow from a boundary, the phenomena related with it, specially in view of practical application. (2) Calculation of the performance of an aeroplane from the aerodynamic data. (3) Experiments on the stability of an aeroplane in flight. (4) Spinning. (5) Choice of the best propeller. The influence of form and dimensions of the aeroplane parts in the slipstream on the efficiency of the propeller. (6) Long distance flights. (7) Experiments in a model tank as a basis for the design of floats and flying boats. (8) Strength calculation of different kinds of wing constructions. (9) Heavy oil engines. (10) Light alloys and composite steels in aeroplane construction. (11) Ice formation on aeroplane parts in flight. (12) The measurement of the height above the ground in an aeroplane or an airship

The languages of the Congress will be English, French, German, Italian and Dutch; the Congress will furnish the necessary interpreters for these languages. Members desiring to speak in other languages are requested to arrange for the use of their own interpreter.

All memoranda should be written in one of the Congress languages, and be accompanied by an abstract, giving the author's conclusions in not more than 300 words, in the language chosen by the author and French.

The memoranda should, if possible, not exceed 16 pages of printing (16 by 24 cm.). If authors propose showing lantern slides or cinema films they are requested to make a note of this in the memoranda. The projections should not take more than ten minutes.

Memoranda should be typed on paper 30 by 20 cm., or as near these measurements as possible, on one side of the paper only, and should be ready by April 30th, 1930, at the latest.

In view of the changed attitude of the Congress in admitting English as an official language (due largely to the efforts of the Society), the Council are very anxious, indeed, to submit on behalf of their members as many important papers to the Congress as possible. Members are asked to communicate with the Secretary at once if they are contemplating submitting any paper, when full particulars will be sent to them of the necessary procedure.

Subscriptions

Members are reminded that their subscriptions for 1930 became due on January 1st last.

The attention of members is drawn to Rule 70, which reads as follows:—

"Any Fellow, Member, Associate Fellow, Associate Member, Associate, Student, Companion, or Founder-Member, whose subscription shall not have been paid before the first day of April, shall be in arrears of subscription and shall not be entitled to attend or vote at any meeting or to receive any publications to which he would be otherwise entitled."

Under this Rule the JOURNAL is not sent to members whose subscriptions are outstanding on April 1st.

Membership Badges

For those members of the Society who wish to have them, a badge has been prepared. The badge shows the symbols of the Society, the peregrine and balloon, in finely chased gilt on a blue enamel background, surrounded by a royal blue border on which appears the lettering "Royal Aeronautical Society, 1866." The badges have been hand made with the greatest care so that they will always retain their original appearance, and it is hoped that members will wear them on all suitable occasions. The price is 5/-, or 5/3 post free.

The Society's Awards

The attention of all members is drawn to the following particulars of the awards made by the Society. For the purpose of making awards the Society's year is considered as being July 1st to June 30th, so that all awards for 1929-1930 will be considered for the period July 1st—June 30th, 1930. Further particulars of any of the awards will be sent on request.

R.38 MEMORIAL PRIZE.

The R.38 Memorial Prize is offered annually, at the discretion of the Council, for the best paper received by the R.Ae.S.I. on some subject of a technical nature in the science of aeronautics. Other things being equal, preference will be given to papers which relate to airships.

The prize is open to members and non-members of any nationality, and its value is 25 guineas.

SIMMS GOLD MEDAL.

The Simms Gold Medal is awarded annually, at the discretion of the Council, for the best paper read in any year before the Society on any science allied to aeronautics, *e.g.*, meteorology, wireless telegraphy, instruments. The medal may be awarded to a member or a non-member of the Society.

TAYLOR GOLD MEDAL.

The Taylor Gold Medal is awarded annually, at the discretion of the Council, for the most valuable paper submitted or read during the previous session before the Society. The medal may be awarded to a member or a non-member of the Society.

SIR CHARLES WAKEFIELD GOLD MEDAL.

The Sir Charles Wakefield Gold Medal is awarded annually, at the discretion of the Council, to the designer of any invention or apparatus tending towards safety in flying. The medal may be awarded to a member or a non-member of the Society.

SOCIETY'S SILVER MEDAL.

The Society's Silver Medal is awarded, at the discretion of the Council, for some advance in aeronautical design, and is open to members and non-members of the Society.

SOCIETY'S BRONZE MEDAL.

The Society's Bronze Medal is awarded under the same conditions as those for the Silver Medal, but for some less important advance in aeronautical design.

THE HERBERT AKROYD STUART LECTURES.

Under the will of the late Mr. Herbert Akroyd Stuart a sum of £700 is held in trust by the Society for the offer of a prize every two years, for the best paper or lecture read or given before the Society on "The Origin and Development of Heavy Oil Aero Engines." The prize is open to members and non-members, and its value is approximately £68. The closing date for the receipt of papers is June 30th, 1930.

EDWARD BUSK MEMORIAL PRIZE.

The Edward Busk Memorial Prize is offered annually for the best paper received by the Society on some subject of a technical nature in connection with aeroplanes (including seaplanes). Its value is 20 guineas. The prize is open to members and non-members of the Society.

PILCHER MEMORIAL PRIZE.

The Pilcher Memorial Prize is offered annually, at the discretion of the Council, for the best paper by a student of the Society on heavier-than-air craft or any analogous subject. Its value is £5.

USBORNE MEMORIAL PRIZE.

The Usborne Memorial Prize is offered annually, at the discretion of the Council, for the best paper by a student of the Society on lighter-than-air craft. Its value is £5.

ELLIOTT MEMORIAL PRIZE.

The Elliott Memorial Prize is awarded to apprentices at Halton on the results of their examinations.

Forthcoming Events

Thursday, February 6th.—Lecture before the Yeovil Branch, on "Aircraft Production Methods," by Mr. D. B. Nivison.

Thursday, February 6th.—Lecture by Mr. Maccoll, on "Modern Aerodynamic Research in Germany," in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2, at 6.30 p.m.

Friday, February 7th.—Lecture by Mr. C. G. Grey, before the Hull and Leeds Branch, on "Aircraft as they ought to be," in the University College, Hull, at 8 p.m.

Thursday, February 13th.—Lecture by Senor J. de la Cierva, on "The Autogiro," in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2, at 6.30 p.m.

Friday, February 14th.—Lecture before the Yeovil Branch, by Flying Officer H. R. W. Waghorn, on "The Schneider Trophy Contest of 1929."

Wednesday, February 19th.—Lecture by Dr. Georgii and Herr Stamer, on "Gliding," in the Lecture Hall of the **Institution of Electrical Engineers,** at 6.30 p.m. A cinema film of gliding will be shown. *Admission by ticket only.*

Thursday, February 20th.—Lecture before the Yeovil Branch, on "The Westland Wapiti in Iraq," by Squadron Leader J. J. Breen, R.A.F.

Thursday, February 20th.—Lecture before the Coventry Branch, on "The Winning of the 1929 Schneider Trophy Contest," by Flying Officer H. R. D. Waghorn.

Friday, February 21st.—Informal Discussion and Dinner at the St. Ermin's Hotel, Westminster, in honour of Dr. Georgii and Herr Stamer. Dinner is at 7.30 p.m. and lounge suits will be worn.

Monday, February 24th.—The Walmsley Memorial Lecture, "Aviation," by Mr. C. R. Fairey, before the Northampton Engineering College Engineering Society.

Thursday, February 27th.—Joint Lecture with the Institution of Automobile Engineers, by Mr. Rowledge, on "Latest Development in Aero Engines," in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2, at **7.45 p.m.** Light refreshments will be served from 7.15 p.m.

Thursday, February 27th.—Lecture before the Yeovil Branch, on "Racing Seaplanes," by a representative of the Supermarine Aviation Works, Ltd.

J. LAURENCE PRITCHARD, *Secretary.*

THE

ROYAL AERONAUTICAL SOCIETY

With which is incorporated the Institution of Aeronautical Engineers

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MONTHLY NOTICES

MARCH, 1930

Annual General Meeting

The Annual General Meeting of the Society will be held on Tuesday, March 25th, 1930, at 6.30 p.m., in the offices of the Society, 7, Albemarle Street, W.1.

The attention of members is drawn to the Council's Report printed in this issue of the Journal and also the Balance Sheet and Income and Expenditure Account of Aerial Science, Ltd.

Any member who wishes to submit any resolution to the Annual General Meeting must do so in writing to the Secretary by March 11th.

Elections to Council

Nominations for election to the Council must be received by the Secretary by Tuesday, March 4th, under Rule 88. Nominations must be signed by one supporter and two seconders, all voters in the R.Ae.S.I., and must be accompanied by an intimation in writing by the candidate that he is willing to serve.

Council Meeting

A Meeting of Council was held in the offices of the Society on Tuesday, February 11th.

Present: Colonel the Master of Sempill, in the Chair, Captain P. D. Acland, Major T. M. Barlow, Mr. Griffith Brewer, Major J. S. Buchanan, Wing-Commander T. R. Cave-Browne-Cave, Captain F. T. Hill, Mr. J. E. Hodgson, Major D. H. Kennedy, Captain A. G. Lamplugh, Mr. R. McKinnon Wood, Mr. C. C. Walker.

Among the business transacted was the following:—Awards of medals and prizes; the Endowment Fund; the award of the R.38 Memorial Prize; the Council's Annual Report; the date and arrangements for the Annual General Meeting.

Awards of the Society

The Council have had under consideration the question of whether members of Council should be eligible for the awards of the Society. The proposal before the Council at present is that they should be eligible, but withdraw from the Awards Committee while any award in which they are concerned is being con-

sidered; that the Awards Committee should make recommendations to the Council regarding awards, and that at least two-thirds of the Committee should not be members of Council.

Members of the Society are expressly invited to give their views on the above at or before the Annual General Meeting, as it is particularly wished to obtain the opinions of members. Any letters addressed to the Secretary should be marked "Awards."

Elections

At a meeting of Council on Tuesday, February 11th, 1930, the following recommendations of the Grading Committee were approved:—

Fellow.—Felix W. Pawlowski.

Member.—Alfred Henry Caple.

Associate Fellows.—Frank Emsley, Ewan Hogan Slattery, Reginald Spencer Stafford (from Student).

Students.—Harold Edward Andrews, George Jeffrey Armstrong, Richard Henry Beeching, Lawrance Valentine Brown, Robert Alfred Copsey Carter, Herbert Aston Clark, Bertram Cornthwaite, William Douglas Gaffney, R. P. Nair, Thomas Pountney, Richard Henry Sainsbury, M. L. Sodhi, Francis Neville Monkhouse Sparks, John Desmond Stratton.

Companions.—Arthur Leighton Angus, George Vincent Carlow (Viscount), Fukumatsu Isikawa, Thomas Arthur Symonds Lloyd.

R.38 Memorial Prize

The R.38 Memorial Prize for 1929 has been awarded to Miss Lyon for her paper entitled "The Strength of Transverse Frames of Rigid Airships." The paper will be published shortly in the Journal.

Photographs

The Council wish gratefully to acknowledge the gift of photographs from Mr. N. Comper for the Society's collection; and of a gift of slides from Mr. Hansell, a student member.

Library

The Council wish gratefully to acknowledge the gift of a number of very interesting postcards and an original programme of the 1911 Circuit of Europe from Captain Howard Reed; and an interesting collection of old air line time tables from Mr. H. R. Trost.

Membership Badges

For those members of the Society who wish to have them, a badge has been prepared. The badge shows the symbols of the Society, the peregrine and balloon, in finely chased gilt on a blue enamel background, surrounded by a royal blue border on which appears the lettering "Royal Aeronautical Society, 1866." The badges have been hand made with the greatest care so that they will always retain their original appearance, and it is hoped that members will wear them on all suitable occasions. The price is 5/-, or 5/3 post free.

Subscriptions

Members are reminded that their subscriptions for 1930 became due on January 1st last.

Fifth International Air Congress

The Fifth International Air Congress will be held at the Hague from the 1st to 6th of September, 1930. The business of the Congress will be divided into five sections:—

A. Aerial Traffic.
B. Science and Technics.
C. Legal Questions.
D. Medical Questions.
E. Aerial Tourism.

The President of the Scientific and Technical Section would appreciate especially the sending of memoranda about:—(1) The separation of the air flow from a boundary, the phenomena related with it, specially in view of practical application. (2) Calculation of the performance of an aeroplane from the aerodynamic data. (3) Experiments on the stability of an aeroplane in flight. (4) Spinning. (5) Choice of the best propeller. The influence of form and dimensions of the aeroplane parts in the slipstream on the efficiency of the propeller. (6) Long distance flights. (7) Experiments in a model tank as a basis for the design of floats and flying boats. (8) Strength calculation of different kinds of wing constructions. (9) Heavy oil engines. (10) Light alloys and composite steels in aeroplane construction. (11) Ice formation on aeroplane parts in flight. (12) The measurement of the height above the ground in an aeroplane or an airship

The languages of the Congress will be English, French, German, Italian and Dutch; the Congress will furnish the necessary interpreters for these languages. Members desiring to speak in other languages are requested to arrange for the use of their own interpreter.

All memoranda should be written in one of the Congress languages, and be accompanied by an abstract, giving the author's conclusions in not more than 300 words, in the language chosen by the author and French.

The memoranda should, if possible, not exceed 16 pages of printing (16 by 24 cm.). If authors propose showing lantern slides or cinema films they are requested to make a note of this in the memoranda. The projections should not take more than ten minutes.

Memoranda should be typed on paper 30 by 20 cm., or as near these measurements as possible, on one side of the paper only, and should be ready by April 30th, 1930, at the latest.

In view of the changed attitude of the Congress in admitting English as an official language (due largely to the efforts of the Society), the Council are very anxious, indeed, to submit on behalf of their members as many important papers to the Congress as possible. Members are asked to communicate with the Secretary at once if they are contemplating submitting any paper, when full particulars will be sent to them of the necessary procedure.

Visit to Junkers' Works

A member of the Society is desirous of making up a party to visit the Junkers' works at Easter. Will any member who would care to join please communicate with the Secretary as soon as possible?

Forthcoming Events

Thursday, March 6th.—" Wind Tunnel and Slotted Wings," by Mr. Russell. Lecture before Halton Branch.

Thursday, March 6th.—" Resistance of Air-cooled Engines and the Townend Ring," by Major F. M. Green, O.B.E., M.Inst.C.E., F.R.Ae.S., and Mr. H. C. H. Townend, A.F.R.Ae.S. Lecture at 6.30 p.m. in the Royal Society of Arts.

Friday, March 7th.—" The Gypsy Aero Engine." Lecture before the Yeovil Branch.

Friday, March 7th.—" Aerodynamic Theory," by H. Glauert. Lecture before the Hull and Leeds Branch.

Monday, March 10th.—" Air Transport," by Herr M. Wronsky. Joint lecture with Institute of Transport in Lecture Hall of the Institution of Electrical Engineers, at 5.30 p.m.

Friday, March 14th.—" Aims and Objects of the Aero-Arctic," by Professor F. Nansen. Joint lecture with Royal Meteorological Society in Lecture Hall of the Institution of Electrical Engineers, at 6.30 p.m.

Monday, March 17th.—" Metal Construction of Aircraft." Lecture before Halton Branch.

Wednesday, March 19th.—" High Altitude Equipment for Aircraft," by Major Stewart. Lecture before Yeovil Branch.

Wednesday, March 19th.—" The New Airships Machinery," by Wing-Commander T. R. Cave-Browne-Cave. Lecture before the Coventry Branch.

Tuesday, March 25th.—Annual General Meeting of the Royal Aeronautical Society at the offices of the Society, at 6.30 p.m.

Thursday, March 27th.—" Aircraft Accessories." Lecture before Yeovil Branch.

J. LAURENCE PRITCHARD, *Secretary.*

THE

ROYAL AERONAUTICAL SOCIETY

With which is incorporated the Institution of Aeronautical Engineers

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MONTHLY NOTICES

APRIL, 1930

Endowment Fund

The Council wish to place on record their grateful thanks for a very generous donation of £100 from Mr. Fairey for the purposes of drawing attention to the Endowment Fund. The Council are giving careful attention to the best method of spending Mr. Fairey's gift, in order that full use shall be made of it.

Subscriptions

The attention of all members is drawn to Rule 70 which states:—

"Any Fellow, Member, Associate Fellow, Associate Member, Associate, Student, Companion or Founder Member, whose subscription shall not have been paid before the first day of April, shall be in arrears of subscription and shall not be entitled to attend or vote at any meeting or to receive any publications to which he would be otherwise entitled."

Under this Rule any members who have not paid their subscriptions by March 31st are not sent the April and subsequent Journals. Owing to the heavy expense of printing the Journal only the necessary number is printed, and it is not possible to guarantee to send members back numbers of the Journal when they pay their subscriptions later in the year.

The Council urge strongly that every member should make a special effort to pay his subscription as soon as possible each year not only to avoid unnecessary expense to the Society, but in order that the printing arrangements for the Journal can be settled on a fair basis.

Elections to Council

The ballot for Council this year constituted a record in the history of the Society. Some fifty per cent. of the voters sent in their ballot papers, the previous record only being of the order of thirty per cent. The Council feel that this increase in interest is due largely to very great progress the Society has made during the past few years under the Presidency of Colonel The Master of Sempill, who has worked indefatigably, during his years of office, to make the Society a real live body. The increase in the voting, the steady increase in membership and activities of the Society, are the very definite results of the President's own energetic leadership and the Council have great pleasure in again drawing the attention of members to his excellent work.

As a result of the ballot the following is the new Council:—

President:
Colonel The Master of Sempill, A.F.C., A.F.R.Ae.S.

Past President:
Air Vice-Marshal Sir W. Sefton Brancker, K.C.B., A.F.C., F.R.Ae.S.

Vice-Presidents:
Air Vice-Marshal Sir Vyell Vyvyan, K.C.B., D.S.O.
Lieut.-Col. J. T. C. Moore-Brabazon, M.C., F.R.Ae.S., M.I.Ae.E.
Mr. H. E. Wimperis, C.B.E., F.R.Ae.S.

Council:

Captain P. D. Acland.
Prof. L. Bairstow, C.B.E., F.R.S., F.R.Ae.S.
Major T. M. Barlow, M.Sc. (Eng.), M.Inst.C.E., M.I.Mech.E., F.R.Ae.S.
Mr. Robert Blackburn, O.B.E., A.M.Inst.C.E., M.I.Mech.E., F.R.Ae.S., M.I.Ae.E.
Mr. M. L. Bramson, A.C.G.I., F.R.Ae.S., M.I.Ae.E.
Mr. Griffith Brewer, F.R.Ae.S.
Major J. S. Buchanan, O.B.E., A.M.I.Mech.E., F.R.Ae.S.
Major G. P. Bulman, O.B.E., B.Sc., A.F.R.Ae.S.
Wing-Cmdr. T. R. Cave-Browne-Cave, C.B.E., M.I.Mech.E., A.M.I.N.A., F.R.Ae.S.
Mr. C. R. Fairey, M.B.E., F.R.Ae.S.
Captain F. T. Hill, F.R.Ae.S., M.I.Ae.E., B.Sc., Wh.Ex.
Captain A. G. Lamplugh, F.R.Ae.S., M.I.Ae.E.
Mr. W. O. Manning, F.R.Ae.S.
Major R. H. Mayo, O.B.E., F.R.Ae.S.
Mr. T. O. M. Sopwith, C.B.E., F.R.Ae.S.
Mr. C. C. Walker, Assoc.M.Inst.C.E., F.R.Ae.S.
Mr. L. A. Wingfield, M.C., D.F.C., A.R.Ae.S.I.

Hon. Treasurer: Major D. H. Kennedy, O.B.E., F.R.Ae.S.

Hon. Solicitor: Lawrence A. Wingfield, A.R.Ae.S.I.

Hon. Librarian: Mr. J. E. Hodgson.

Hon. Accountant: Mr. A. N. D. Smith, F.I.C.A.

Council Meeting

A Meeting of Council was held in the offices of the Society on Tuesday, March 11th:—

PRESENT: Colonel the Master of Sempill, President, in the Chair.

Captain P. D. Acland.	Captain A. G. Lamplugh.
Major T. M. Barlow.	Mr. W. O. Manning.
Mr. M. L. Bramson.	Mr. C. C. Walker.
Major J. S. Buchanan.	Mr. L. A. Wingfield.

Among the business transacted was the following:—Arrangements for the Annual General Meeting; consideration of the reports of the Finance and Grading Committees; consideration of the Wilbur Wright Memorial Lecture for 1930; and consideration of the papers for the Vth International Congress.

Elections

At a Meeting of Council held on Tuesday, March 11th, the following recommendations of the Grading Committee were approved:—

Fellows.—Sydney Brew (from Associate Fellow), William Lockwood March (from Associate Fellow).

Associate Fellows.—William Robinson Andrews, Desmond Herlouin DeBurgh, Peter Du Cane, John Leslie Emery, Ronald Rolfe McWhinnie, Percy Maxwell Muller, Henry Furnell Peaty, Francis Aubrey Roberts, Stewart Scott-Hall (from Student).

Associates.—The Hon. Lady Mary Bailey, Henry William Dunn, Robert Henry Thomas, Frederick William Victor Webber, Miss Amy Johnson (from Companion).

Students.—Henry Owen Baker, Donald Lambert Brown, Alfred Horace Elkington, Bernard William Locke, Richard Ronald Foster Mann, Alfred William James Norkett, William Stanley Reed, Leslie Charles Richardson, Ivan Morley Williams, William Wilson.

Companions.—John Raymond Ashwell-Cooke, Miss Constance Ruth Leathart, A. F. de Ledesma, Miss Edith Mary Webb.

Contributions to the Journal

In response to inquiries from a number of members the Editor will always be glad to consider contributions on any subject dealing with aeronautics or any of its allied subjects. The Council would like to impress upon all members that they should look upon the Journal as the proper place of publication of any original work which they may have done. The Journal circulates all over the world and is recognised to be the most authoritative publication of its kind now printed.

By supporting the Journal in this way members will make the Journal still more influential and will enable it to increase its already wide circulation, and in this way directly benefit the Society as a whole.

First International Congress on Safety in the Air

The first International Congress on Safety in the Air will be held in Paris on December 10th-23rd next. Full particulars of the Congress may be obtained from the Commissariat General, 23 Avenue de Messine, Paris (8e).

Manchester Branch

The Manchester Branch has been re-organised on the lines of the remaining Branches of the Society. The new President of the Branch is Mr. J. D. Siddeley, and the other officers and Committee are:—

Chairman: Mr. R. Chadwick.

Hon. Secretary: Mr. F. Paxton.

Assistant Hon. Secretary: Mr. J. Colley.

Treasurer: Mr. A. D. Scarlett.

Committee: Messrs. Andrews, Cameron, Gaskin, McCormick, Oldham, Shawley, Taylor and Welch.

Already the reorganisation has increased the membership to over a hundred under the active and enthusiastic guidance of Mr. Chadwick, and a series of lectures has been arranged every Tuesday evening. A model aeroplane section has been formed and a gilding section is under consideration.

Yeovil Branch

The membership of the Yeovil Branch now stands at 358, an increase of 108 since October last. The Council feel that Mr. Gaunt, the Hon. Secretary of the Branch, and all its energetic officials, are to be heartily congratulated, not only upon the fine membership, but upon the very excellent series of lectures which have been read before the Branch. The work of running the Branch has become so heavy that it has been found necessary to appoint a special Secretarial Assistant, Mr. C. J. King. A very successful series of Instructional Classes for Ground Engineering has formed a part of the activities of the Branch.

Donations

The Council wish to place on record their grateful thanks for the gift of photographs of the aircraft of the DeHavilland Company from Messrs. DeHavilland. The photographs are of the DeH aeroplanes from DeH1 to the new Moth Three.

The Council wish also to acknowledge the gift of a number of old Journals from Sir Charles Bright. They hope that all members who have Journals to spare will follow Sir Charles Bright's example, in order that the Society's files may be made complete.

The Council have also to thank Mr. F. R. B. King for a very interesting photograph of the Willows airship.

Journal Wanted

The Society has no number in stock of the Journal for December, 1928. Will any member who has a copy to spare communicate with the Secretary?

Correction

The American reference number given on page 269 of the March Journal of the article by L. F. R. Fell on British Water-Cooled Engines and *Aircraft Engineering* for December, 1929, should have been a British number.

Membership Badges

For those members of the Society who wish to have them, a badge has been prepared. The badge shows the symbols of the Society, the peregrine and balloon, in finely chased gilt on a blue enamel background, surrounded by a royal blue border on which appears the lettering " Royal Aeronautical Society, 1866." The badges have been hand made with the greatest care so that they will always retain their original appearance, and it is hoped that members will wear them on all suitable occasions. The price is 5/-, or 5/3 post free.

Major B. F. S. Baden Powell

The following is an extract from the Council Minutes of April 21st, 1880, fifty years ago.

" At a Meeting of the Council of the Aeronautical Society held at Stafford House, April 21st, 1880, there were present Mr. Glaisher, Mr. Wright, Mr. Wenham and Mr. Breary. The following gentlemen were elected members:—

Henry Novra.
Rev. S. Behrens.
B. F. S. Baden Powell.
Howard Lane.
A. H. H. Jeyse.
Paul Pfeiderer."

The membership at that time was exactly 80 and included such well-known names as James Glaisher, Otto Lilienthal, Thomas Moy, John Stringfellow and P. H. Wenham.

Major B. F. S. Baden Powell, now an Honorary Fellow of the Society, is the oldest living member, and from the above extract it will be seen that on Monday, April 21st, 1930, he will have completed fifty years continuous membership, a remarkable record. In 1892 Major Baden Powell attended his first meeting as Member of Council, and from then onwards delivered many papers before the Society and took part in the discussions on many others. Between May, 1892, and November, 1896, the Society was barely existing. At the latter Council Meeting Major Baden Powell agreed to act as Honorary Secretary. The balance in hand was £5 5s. 0d. The new Hon. Secretary immediately began to increase interest in the Society. The Journal, which had lapsed, was issued quarterly under his editorship, and he was elected an Honorary Member of the Society. It is interesting to note that in March, 1897, Major Baden Powell reported that the number of members was 39, including 4 honorary members, and the balance in hand was £15. A note in the Council Minutes says "The Society did not possess sufficient funds to provide a suitable Quarterly Journal without outside support. However, the Hon. Secretary (Major B. F. S. Baden Powell) suggested issuing such a Journal entirely at his own expense and risk."

At the Meeting of Council held on December 6th, 1899, the following resolution was passed, following Major Baden Powell's departure for South Africa on the outbreak of War.

"The Council of the Aeronautical Society at this meeting to-day, take this, the earliest opportunity since the departure of Major B. F. S. Baden Powell on service in South Africa, to record their best thanks to him for the great interest he has shown in the affairs of the Society, and for the very efficient manner in which he has conducted the duties of Hon. Secretary. The Council look forward in giving Major Baden Powell a hearty welcome on his return to England."

It was stated in a succeeding minute that Major B. F. S. Baden Powell, when he became Hon. Secretary, virtually re-established the Society. In July, 1900, Major Baden Powell was elected President of the Society, a post he held for seven years. On his resignation in 1907, the following letter was sent to him by the Vice-President, Lt.-Col. F. Trollope:—

"My dear Baden Powell,

I am requested by the Council of the Aeronautical Society of Great Britain to convey to you the thanks of the Society for the valuable services you have rendered during your seven years term of office as President.

On behalf of the Society allow me to give you our thanks for the work you have done, and to express our pleasure, that as a member of the Council, we shall still have the benefit of your advice in matters affecting the welfare of the Society."

In 1908 Major Baden Powell was elected a Vice-President of the Society.

Major Baden Powell was one of the first to experiment with man-lifting kites, and, as stated in the Journal (April, 1897), "the first well-authenticated occasion on which a man was raised by a kite was on June 27th, 1894, when Captain Baden Powell, Scots Guards, conducted some experiments at Pirbright Camp." Major Baden Powell read a number of papers before the Society on his kites, and, as is well-known, his system of kites was adopted by the army authorities for some time. Previously, Major Baden Powell was a leading spirit in military ballooning. During the Boer War Major Baden Powell's kites were successfully used for reconnaissance, photography and wireless. It was in 1881

that Major Baden Powell made his first balloon ascent, and in 1884 he bought the balloon Eclipse, and made several ascents in it at Aldershot. In 1887 he began his experiments with kites, but it was not until 1892 he began his systematic series of experiments, which culminated in the success of June, 1894. In March, 1898, Major Baden Powell read an exhaustive paper before the members of the Society of Arts on "Kites in Theory and Practice," for which he obtained the Society's silver medal.

The then President of the Society did not neglect the heavier-than-air craft. In March, 1904, he read a paper on "Experiments with Aerial Screw Propellers" before the Society, and reference to the April Journal of that year shows how methodically the experiments were carried out. Actually 350 tests were carried out on various types of airscrews.

In the Journal for July, 1904, Major Baden Powell describes at length his experiments with gliders at the Crystal Palace, with a view to building a power-driven aeroplane. In these experiments it is worthy to record that Major Baden Powell's most enthusiastic helper was a Mr. J. T. C. Moore-Brabazon, who carried out many of the preliminary glides. The Journal during the period Major Baden Powell was acting as Hon. Secretary or President contains many articles from his pen, all of which, in some form or other, indicated his firm belief that the conquest of the air was close at hand, and by his optimism he infused new life and energy into the sick child of aviation. It is, indeed, no exaggeration to say, that Major Baden Powell was one of those far-sighted men who helped to bring that child up to a sturdy manhood.

Major B. F. S. Baden Powell joined the Aeronautical Society of Great Britain before the majority of its present members were born. He not only saved it from extinction, but when he laid down the reins of office after fifteen years continuous work as a member of Council, Honorary Secretary and President, he saw it was well on its way to the position it now holds as the most authoritative body of its kind in the world.

In this brief note, compiled largely from Council Minutes and the Journal, by the Secretary, it has been found impossible to pay a full and proper tribute to the work of the oldest member of the Society. In a future issue such a tribute will be paid and placed on permanent record in the pages of the Journal by one who has had a more intimate knowledge of events in Major Baden Powell's life than could be possible by the present writer, who was one of more members not born when Major Baden Powell joined.

The note can end in the confident wish, expressed by the writer on behalf of every member, that Major Baden Powell has many more years before him to follow with pride the growth of the "Aeronautical Society of Great Britain," for which he did so much during critical years.

Forthcoming Events

Thursday, April 3rd.—The Technical Organisation of the Compagnie Generale Aeropostale, by P. Grimault. A lecture before the Society at 6.30 p.m. in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2.

J. LAURENCE PRITCHARD, *Secretary.*

THE

ROYAL AERONAUTICAL SOCIETY

With which is incorporated the Institution of Aeronautical Engineers

MONTHLY NOTICES
MAY 1930

Council Meeting

A meeting of Council was held on Tuesday, April 15th, at the offices of the Society. Among the business transacted was the following:—Discussion of the Wilbur Wright Memorial Lecture; the Reports of the Finance and Grading Committees; arrangements for the Secretary's Visit to Canada; the Election of the Committees of Council for 1930-31.

Major B. F. S. Baden-Powell

The following telegram was sent by the President on behalf of the Society to Major B. F. S. Baden-Powell on the completion, on April 21st, of fifty years' continuous membership of the Society:—

> "Very cordial congratulations Mister Past President from the Council and Members of the Royal Aeronautical Society on the 50th anniversary, Monday, the twenty-first, of your membership. Your splendid services to aeronautics and to the oldest Aeronautical Society in the world will never be forgotten.—SEMPILL, *President.*"

At the Council Meeting held on April 15th the following resolution was unanimously passed:—

> "The Council in recording in their minutes that on April 21st, 1930, Major B. F. S. Baden-Powell, a former President of the Society and for many years a Member of Council, had been a member of the Society for fifty years, wish to extend their heartiest good wishes to him for the future, and to congratulate him upon the completion of a record unique in the Society's history."

Elections

At a meeting of Council, held on Tuesday, April 15th, the following recommendations of the Grading Committee were approved:—

Fellow.—A. Graham Clark (re-elected).

Associate Fellows.—Robert Boorman, Seaward Newnham Cole, Leslie William Johnson, John Kenworthy, Charles Isted Morris, William George Arthur Perring, Frederick Pilling (from Associate), Harold Bertram Pond (from Associate Member).

Associate Members.—Edmund Neil Boileau Bentley (from Associate), Neal Anthony Ferguson, William George Kentfield.

Associates.—Purshottam Mwfhji Kabali (from Student), Ram Keshave Koratkar, Denis Moore Langford, Wilfrid Thomas Morgan, James Graham Woollard.

Students.—Andrew Dent Balmain, Charles William Barraclough, Alfred Owen Waldron Bennett, Daniel Cook, Thomas Dawson, Robert Cecil Hinkin, Lewis Max Jenkins, Reginald Francis Lloyd, Robert McVie, Griffith Henry Richards, Guy George Shand, Frank Maurice Startup, John Ellis Stevens, Vincent Jacques Willems.

Companions.—Alfred Gordon Berg, Miss Doris Mona Hirst (from Student).

Subscriptions

The attention of all members is drawn to Rule 70 which states:—

"Any Fellow, Member, Associate Fellow, Associate Member, Associate, Student, Companion or Founder Member, whose subscription shall not have been paid before the first day of April, shall be in arrears of subscription and shall not be entitled to attend or vote at any meeting or to receive any publications to which he would be otherwise entitled."

Under this Rule any members who have not paid their subscriptions by March 31st are not sent the April and subsequent Journals. Owing to the heavy expense of printing the Journal only the necessary number is printed, and it is not possible to guarantee to send members back numbers of the Journal when they pay their subscriptions later in the year.

The Council urge strongly that every member should make a special effort to pay his subscription as soon as possible each year not only to avoid unnecessary expense to the Society, but in order that the printing arrangements for the Journal can be settled on a fair basis.

Donations

The Council wish to thank the following for gifts of Journals and books to the Library:—Mr. F. W. Hills, for 1929 Journals; Mr. T. Henry Turner, three German air books purchased in Ruhleben Camp; Mr. Douglas M. Ferrier, copy of December, 1928, Journal.

De Havilland Aeronautical Technical School

The De Havilland Aeronautical Technical School are giving a Students' Dance on Friday, May 9th, 1930, at the Portman Rooms, to which members of the Society are invited. Tickets (4/- single, 7/6 double) may be obtained from Mr. A. T. Eadon, Stag Lane Aerodrome, Edgware.

Contributions to the Journal

In response to inquiries from a number of members the Editor will always be glad to consider contributions on any subject dealing with aeronautics or any of its allied subjects. The Council would like to impress upon all members that they should look upon the Journal as the proper place of publication of any original work which they may have done. The Journal circulates all over the world and is recognised to be the most authoritative publication of its kind now printed.

By supporting the Journal in this way members will make the Journal still more influential and will enable it to increase its already wide circulation, and in this way directly benefit the Society as a whole.

Membership Badges

For those members of the Society who wish to have them, a badge has been prepared. The badge shows the symbols of the Society, the peregrine and balloon, in finely chased gilt on a blue enamel background, surrounded by a royal blue border on which appears the lettering "Royal Aeronautical Society, 1866." The badges have been hand made with the greatest care so that they will always retain their original appearance, and it is hoped that members will wear them on all suitable occasions. The price is 5/-, or 5/3 post free.

J. LAURENCE PRITCHARD, *Secretary*.

OBITUARY

Pandia Antonio Ralli

The Council have learnt with the deepest regret of the death in a nursing home, at the early age of 41, of Mr. P. A. Ralli, an Associate Fellow of the Society.

Mr. Ralli, who had been ill for some months, was one of the most brilliant scientific men in aviation, and his death will leave a gap which will be difficult to fill. Educated at Lausanne as an electrical engineer, with a wide knowledge of mathematics and physics, Mr. Ralli joined the technical staff of the Fairey Aviation Company in 1916.

From the beginning of his work there his outstanding ability was recognised. He carried out original research on the strength and performance of high-speed and high performance aircraft, which proved of the utmost value. He made a special study of the problems connected with airscrews, and it was largely due to his work that the Schneider Trophy was won from Italy in 1927 and retained in 1929. For his work on airscrew design he was awarded, in 1928, the Silver Medal of the Society.

All those who worked under Mr. Ralli, who was head of the Technical Department at Messrs. Fairey's, found his advice and experience placed ungrudgingly at their disposal. Their loss is a loss to aviation as a whole of a man of great personal charm and ability.

THE

ROYAL AERONAUTICAL SOCIETY

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MONTHLY NOTICES

JUNE 1930

The Secretary

The Secretary and Editor left England on May 23rd on a visit to Canada and New York on behalf of the Society. He expects to be away until the end of July.

Council Meeting

A Meeting of Council was held in the offices of the Society on Friday, May 16th, 1930.

Present: Colonel the Master of Sempill, President, in the chair.

Captain P. D. Acland.	Wing Cdr. T. R. Cave-Browne-Cave.
Professor L. Bairstow.	Mr. C. R. Fairey.
Major T. M. Barlow.	Captain F. T. Hill.
Mr. M. L. Bramson.	Captain A. G. Lamplugh.
Mr. Griffith Brewer.	Mr. W. O. Manning.
Major J. S. Buchanan.	Sir Vyell Vyvyan.
Major G. P. Bulman.	Mr. L. A. Wingfield.

The Secretary and Miss Jarvis.

Among the business transacted was the following: The final arrangements for the 18th Wilbur Wright Memorial Lecture; the Annual Council Dinner; Papers for the Vth International Congress; the new lease for the Society's present premises; the Report of the Finance Committee; the Report of the Grading Committee; consideration of nominations for the President for 1930-31; the election of a representative of the Society on the Council of the British Gliding Association.

Elections

The following recommendations of the Grading Committee were approved by the Council at their meeting on May 16th:—

Fellow.—Oliver Edwin Simmonds (from Associate Fellow).

Associate Fellows.—Frank Holroyd, Lachlan Donald Mackintosh, Percy Bickmore Whillier.

Associate.—Henry O'Neil DeHane Segrave.

Students.—Frank Bernard Abbott, William Kenneth Austin, Christopher Henry George Barnes, William George Cox, Edward James Iltid Nicholl, Reginald Alfred Norman, Ian Charles Stuart Rose, Norman Brayford Scott.

Dinner to Lord Wakefield of Hythe

On the occasion of the dinner and dance to Lord Wakefield of Hythe on Thursday, May 15th, the following telegram was received by the President:—

> " I cordially associate myself with the tribute that is being paid by the Royal Aeronautical Society to Lord Wakefield for his outstanding services to British Aviation. They are of National and Imperial value.
>
> ALBERT, *Patron.*"

Donations

The Council wish to thank Mr. Griffith Brewer for a bound copy of " Les Premiers Hommes-Oiseaux, Wilbur et Orville Wright." This was published in Paris in 1909 and contains a complete account of the work and flights of the Brothers Wright in the United States and France up to that date.

The Council also wish to thank Messrs. Rolls-Royce, Ltd., for a gift of 23 slides to the Society's collection. These slides show various types of Rolls-Royce aero engines.

Income Tax

For the information of members the following letter is reprinted:—

Somerset House,
14th August, 1928.

Dear Sir,

Further to your interview with Mr. Stanley at this office on the 19th July, I am now in a position to inform you that the Board of Inland Revenue will not raise objection to the allowance as an expense for Income Tax purposes of annual subscriptions paid by members who are

(i) Assessable under Schedule D of the Income Tax Acts in respect of professional or trading profits, subject to the decision of the Commissioners who make the assessment that such subscriptions are sufficiently closely related to the business carried on; or

(ii) Assessable under Schedule E in those cases only in which continual membership of the Society is an essential condition of the terms of appointment.

Yours faithfully,
GEO. WILCOCK,
Principal Inspector of Taxes.

Capt. J. L. Pritchard, *Secretary,*
Royal Aeronautical Society.

Membership Badges

For those members of the Society who wish to have them, a badge has been prepared. The badge shows the symbols of the Society, the peregrine and balloon, in finely chased gilt on a blue enamel background, surrounded by a royal blue border on which appears the lettering " Royal Aeronautical Society, 1866." The badges have been hand made with the greatest care so that they will always retain their original appearance, and it is hoped that members will wear them on all suitable occasions. The price is 5/-, or 5/3 post free.

Annual General Meeting

The Annual General Meeting of the Society was held on March 26th, 1930, in the Offices of the Society.

Present:

President: Colonel the Master of Sempill, in the chair.

Council: Messrs. Acland, Barlow, Bramson, Brewer, Cave-Browne-Cave, Hill, Hodgson, Manning, Vyvyan, Wimperis and Wingfield.

Ordinary Members: Messrs. Balston, Belaiew, Borlase-Matthews, G. L. O. Davidson, Eadon, Foord, Howard-Flanders, Langley, Merton, Pickles and Thurston.

The Secretary, Miss Jarvis and Miss Todd.

The President, in opening the meeting, said that, acting as the spokesman of the Council, he wished to pay special tribute to the great help the Society had received during the past year from Mr. Fairey, who had made a special donation to the Society's funds for the purpose of increasing the Endowment Fund; to Captain Acland who, as chairman of the S.B.A.C., was largely instrumental for obtaining the generous grant of £500 to the Society for the purposes of the Aero Exhibition at Olympia; to Mr. Handley Page, the present chairman of the S.B.A.C., for his aid in obtaining the continuation of the S.B.A.C. grant of £250 a year; and to Mr. F. R. Simms, of the S.M.M.T., for his help in obtaining a further grant of a similar sum from the S.B.A.C.

Dr. Thurston raised the point of Income Tax rebate which could be obtained by members in the same way as was done by other societies. It was pointed out that certain facilities had already been obtained, and the whole question of Income Tax payable by the Society and its members was under constant review. (The original letter from the Inspector of Taxes is reprinted in these notes.—SECRETARY.)

A discussion followed on the awards of medals and prizes to Members of Council. Opinion was divided and the matter was referred back to the Council for further consideration.

In seconding the adoption of the Council's Report, Sir Vyell Vyvyan said that there was no question that the progress of the last few years had been in a very large measure due to the untiring energy of the Master of Sempill. He had never spared himself, and the Society was to be congratulated on the President it had.

Mr. Wimperis proposed, and Captain Acland seconded, that Messrs. Price, Waterhouse and Co. be re-appointed auditors. The resolution was carried unanimously.

The following were appointed scrutineers for elections to Council: Messrs. Balston, Foord, Langley, Manning and Pickles. The result of the ballot was published in the April JOURNAL.

J. LAURENCE PRITCHARD, *Secretary*.

THE

ROYAL AERONAUTICAL SOCIETY

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MONTHLY NOTICES

JULY 1930

President

The Council at their meeting on 24th June, 1930, unanimously elected Mr. C. R. Fairey, M.B.E., F.R.Ae.S., as President-designate. Mr. Fairey will assume office at the end of September, 1930, when the Presidency is vacated by the Master of Sempill.

The Master of Sempill was elected Chairman of the Royal Aeronautical Society in June, 1926, and took office in October, 1926. In June, 1927, he was re-elected for the year 1927-8. Towards the end of 1927 arrangements were made whereby the Institution of Aeronautical Engineers became incorporated with the Royal Aeronautical Society, and in January, 1928, the Master of Sempill was elected to serve as the first President of the Society under the new rules that had been brought into force to deal with the various questions arising out of the amalgamation. The new rules, amongst other things, abolished the office of Chairman, and considerably altered the duties of the President, bringing them into line with those of other scientific and technical institutions.

The Master of Sempill filled the office of President until the Presidential elections took place in June, 1928, when he was re-elected President for the period 1928-9, and in June, 1929, he was again elected for the period 1929-30.

The Master of Sempill, having served for the maximum period of time that is allowed by the rules, is not eligible for re-election.

The office of President has existed since the formation of the Society 65 years ago, but up to 1928 the bulk of the duties of the Society had been fulfilled by the Chairman.

The previous Presidents were:—

1866-1895 His Grace the Duke of Argyll, K.T.
1896-1899 In abeyance.
1900-1907 Major B. F. S. Baden-Powell, F.R.A.S., F.R.Met.Soc.
1908-1911 E. P. Frost, Esq.
1912-1918 In abeyance.
1919-1925 The Rt. Hon. the Lord Weir of Eastwood, P.C.
1926-1927 Air Vice-Marshal Sir W. Sefton Brancker, K.C.B., A.F.C., F.R.Ae.S.

Vice-Presidents

At the same meeting the elections for Vice-Presidents were dealt with. The three existing Vice-Presidents were re-elected for 1930-31—Air Vice-Marshal Sir Vyell Vyvyan, K.C.B., D.S.O., Lieut.-Col. J. T. C. Moore-Brabazon, M.C., F.R.Ae.S., M.I.Ae.E., and Mr. H. E. Wimperis, C.B.E., F.R.Ae.S. (Director of Scientific Research). Professor L. Bairstow, C.B.E., F.R.S., F.R.Ae.S.

(Zaharoff Professor of Aviation, University of London, and Director of School of Aviation, Imperial College of Science and Technology) was elected an additional Vice-President for the same period.

Council Meeting

At the Council Meeting on 24th June the following were present:—

Colonel the Master of Sempill, A.F.C., A.F.R.Ae.S. (President) in the Chair.

Captain P. D. Acland.
Professor L. Bairstow.
Major T. M. Barlow.
Mr. M. L. Bramson.
Mr. Griffith Brewer.
Major G. P. Bulman.
Mr. C. R. Fairey.
Major D. H. Kennedy.
Captain A. G. Lamplugh.
Mr. W. O. Manning.
Mr. C. C. Walker.
Mr. H. E. Wimperis.
Mr. L. A. Wingfield.

Staff: Miss Jarvis and Miss Todd.

Among the other business transacted was the following:—Papers for the Vth International Air Congress; the Report of the Finance Committee; the Report of the Grading Committee; the Report of the Special Committee set up by the Council to consider future policy in regard to Awards.

Elections

The following recommendations of the Grading Committee were approved by the Council at their meeting on 24th June:—

Member.—Reginald Rhodes (from Associate Member).

Associate Fellows.—Reginald Arthur Beaumont, Harold Anthony Oaks, Archibald Edward Russell (from Associate Member).

Associates.—Mlle. S. H. M. G. Lippens, Alfred James Nicholas, William Edward Perkins.

Students.—Charles John Adamson, Richard Glyn Jones, Charles William Morris, Samuel McNair Park, George Shone, Derek Wright.

Wilbur Wright Memorial Lecture

On 30th May, 1930, in the Lecture Theatre of the Royal Society of Arts, the Eighteenth Wilbur Wright Memorial Lecture was read by Mr. H. R. Ricardo, F.R.S., F.R.Ae.S., M.I.A.E., Assoc.M.Inst.C.E., on "The Development and Progress of the Aero Engine." Colonel the Master of Sempill, A.F.C., A.F.R.Ae.S., President of the Royal Aeronautical Society, occupied the chair, and a large and distinguished audience was present.

Previous to the reading of the lecture, the President handed to Mr. (now Sir) F. H. Royce the Silver Medal of the Society which was awarded to him at the end of 1929 for his conspicuous work in the development of the Rolls-Royce Aero Engines, and in particular the engine of the winning Schneider Trophy machine in 1929—the S.6.

At the conclusion of the lecture, a vote of thanks to Mr. Ricardo was proposed by Mr. H. E. Wimperis, C.B.E., F.R.Ae.S. (Director of Scientific Research at the Air Ministry and a Vice-President of the Society), and seconded by Mr. Loughnan Pendred, M.I.Mech.E., President of the Institution of Mechanical Engineers.

The following telegrams were sent and received on this occasion:—

To Mr. Orville Wright.

Once again we are privileged to pay homage to the memory of your distinguished brother, and we also wish to express great pleasure in the knowledge that you are still playing a prominent part in the development of aeronautics.

The memorial lecture this year deals with aircraft engine development, a peculiarly appropriate subject, since the name of Wright will be handed down to posterity as that of the first person in the world to pilot a power-driven aeroplane.

We would welcome observations on the horse-power you found necessary to make the first flights.

Sempill, *President.*

From Mr. Orville Wright.

Greetings to Members assembled for the Wilbur Wright Lecture. Answering inquiry, our nineteen three estimate of power required for flight of Kitty Hawk machine was a little over nine horse-power at twenty-five miles per hour. In flight the motor developed approximately twelve horse-power and the actual speed of machine, according to our measurements, was thirty-one miles per hour.

Orville Wright.

The Annual Council Dinner was held after the lecture, at the Athenæum, and following is a list of Council and their guests who were present:—

Colonel the Master of Sempill (President) in the chair; Air-Marshal Sir John F. A. Higgins, K.C.B., K.B.E., D.S.O., A.F.C. (Air Member for Supply and Research); Sir Richard T. Glazebrook, K.C.B., F.R.S., F.R.Ae.S. (Chairman of the Aeronautical Research Committee); F. Handley Page, Esq., C.B.E., F.R.Ae.S. (Chairman of the Society of British Aircraft Constructors, Ltd.); Lieut.-Colonel M. O'Gorman, C.B., D.Sc., M.Inst.C.E., M.I.Mech.E., M.I.E.E., M.I.A.E., F.R.Ae.S. (Vice-Chairman of the Royal Aero Club); Gerald Merton, Esq., M.C., M.A., Ph.D., F.R.Ae.S. (Chairman of the Air League of the British Empire); Loughnan Pendred, Esq., M.I.Mech.E. (President of the Institution of Mechanical Engineers); E. H. Blake, Esq. (President of the Society of Motor Manufacturers and Traders, Ltd.); H. R. Ricardo, Esq., F.R.S., F.R.Ae.S., M.I.A.E., Assoc.M.Inst.C.E.; Air Vice-Marshal Sir W. Sefton Brancker, K.C.B., A.F.C., F.R.Ae.S.; Air Vice-Marshal Sir Vyell Vyvyan, K.C.B., D.S.O.; H. E. Wimperis, Esq., C.B.E., F.R.Ae.S.; Lieut.-Colonel J. T. C. Moore-Brabazon, M.C., F.R.Ae.S., M.I.Ae.E.; Capt. P. D. Acland; Professor L. Bairstow, C.B.E., F.R.S., F.R.Ae.S.; Major T. M. Barlow, M.Sc.(Eng.), M.Inst.C.E., M.I.Mech.E., F.R.Ae.S.; M. L. Bramson, Esq., F.R.Ae.S., M.I.Ae.E.; Griffith Brewer, Esq., F.R.Ae.S.; Major J. S. Buchanan, O.B.E., F.R.Ae.S., A.M.I.Mech.E.; Major G. P. Bulman, O.B.E., B.Sc., A.F.R.Ae.S.; Wing Commander T. R. Cave-Browne-Cave, C.B.E., F.R.Ae.S. M.I.Mech.E., A.M.I.N.A.; C. R. Fairey, Esq., M.B.E., F.R.Ae.S.; Capt. F. T. Hill, F.R.Ae.S., M.I.Ae.E.; Capt. A. G. Lamplugh, F.R.Ae.S., M.I.Ae.E.; W. O. Manning, Esq., F.R.Ae.S.; C. C. Walker, Esq., F.R.Ae.S., Assoc.M.Inst.C.E.; L. A. Wingfield, Esq., M.C., D.F.C.; Major D. H. Kennedy, O.B.E., F.R.Ae.S.; and J. E. Hodgson, Esq.

During the evening the following presentations were made:—

To Sir Richard Glazebrook, Chairman of the Aeronautical Research Committee, a Silver Box bearing the inscription :—

> " 30th April.—Presented to Sir Richard Glazebrook, K.C.B., F.R.S., F.R.Ae.S., by the President and Council of the Royal Aeronautical Society, to commemorate the Twenty-first Anniversary of the founding of the Advisory Committee for Aeronautics, 30th April, 1909."

To Lieut.-Colonel J. T. C. Moore-Brabazon (a Vice-President of the Royal Aeronautical Society), a Silver Aneroid bearing the inscription :—

> " 2nd May, 1930.—Presented to Lieut.-Colonel J. T. C. Moore-Brabazon, M.C., F.R.Ae.S., M.I.Ae.E., by the President and Fellow Members of Council of the Royal Aeronautical Society, to commemorate the Twenty-first Anniversary of his flight on 2nd May, 1909—the first flight in a power-driven aeroplane piloted by a British subject in the British Isles."

Fifth International Air Congress

The following papers have been sent through the Society to the Vth International Air Congress which will be held at The Hague from 1st to 6th September, 1930 :—

Flying and Landing in Fog, by R. S. Capon, Esq., B.A., F.R.Ae.S.

The Uses and Limitations of Mechanical Tests, by W. D. Douglas, Esq., F.R.C.Sc.I., F.R.Ae.S.

Air-Cooled Compression Ignition Engines, by A. H. R. Fedden, Esq., F.R.Ae.S.

Aeronautical Research in England. The Aeronautical Research Committee, 1920-30, by Sir Richard Glazebrook, K.C.B., F.R.S., F.R.Ae.S.

The Present-Day Requirements for Aerodrome and Air Route Lighting, by Dr. W. M. Hampton, Ph.D., F.Inst.P., and Captain C. E. Ward.

Airscrew Body Interference, by C. N. H. Lock, Esq., A.F.R.Ae.S.

Problems of Air Transport from the Pilot's Point of View, by Captain N. Macmillan, M.C., A.F.C., A.F.R.Ae.S., A.M.I.Ae.E.

The Ground Organisation required by Air Transport, by Major R. H. S. Mealing, A.R.Ae.S.I.

Experiments in a Model Tank as a Basis for the Design of Floats and Flying Boats, by R. J. Mitchell, Esq., F.R.Ae.S.

The Effect of Engine Gearing on Aircraft Performance, by R. K. Pierson, Esq., B.Sc., A.M.Inst.C.E., F.R.Ae.S.

The Compressed Air Tunnel under Construction at the National Physical Laboratory, by E. F. Relf, Esq., F.R.Ae.S.

The Townend Ring, by H. C. H. Townend, Esq., B.Sc., A.F.R.Ae.S.

Responsibilities of the Pilot and Navigator under the Warsaw Convention, by L. A. Wingfield, Esq., M.C., D.F.C., A.R.Ae.S.I.

International Commission for the Study of Motorless Flight

At the International Commission for the Study of Motorless Flight, which sat at Frankfurt on 14th June, Colonel the Master of Sempill, President of the Royal Aeronautical Society, was elected a Vice-President of the International Soaring Flight Committee which was formed on that occasion.

Yeovil Branch

On 30th May the Westland Aircraft Works were honoured by an impromptu visit of H.R.H. the Prince of Wales, on his way back to London from Torquay. The Prince was flying in his private " Moth " with Squadron Leader Don, and accompanied by Sir Lionel Halsey piloted by Flight Lieut. Fielden. Owing to the hour of arrival the actual works were closed, but His Royal Highness was welcomed by Mr. R. A. Bruce, Managing Director, and by Flight Lieut. Paget and Mr. Byron. Senior members of the staff were soon on the spot, and the Prince and his party were taken round the aircraft shops. His Royal Highness showed great interest in the latest types of machines on view; and before leaving the party were entertained to an impromptu tea in Mr. Bruce's office.

Daniel Guggenheim Medal

The following Memorandum has been received from Mr. Griffith Brewer, who is the Royal Aeronautical Society's representative on the Daniel Guggenheim Medal Board of Award:—

DANIEL GUGGENHEIM MEDAL FOR AERONAUTICS

AWARDED TO LUDWIG PRANDTL, GOETTINGEN, GERMANY.

" The second Daniel Guggenheim gold medal for notable achievement in aeronautics has just been awarded to Dr. Ludwig Prandtl, Professor at the University of Goettingen, Germany, ' for pioneer and creative work in the theory of aerodynamics.' Dr. Prandtl is one of the world's most eminent authorities on aerodynamics and other sciences underlying the art of aviation. He is also well known as an investigator and teacher of the laws of mechanics, thermodynamics and the flow of fluids, particularly air and other gases.

" Last Fall, Dr. Prandtl travelled eastward from his home city as a delegate to the World Engineering Congress in Japan at the end of October and the beginning of November. He presented an important paper at this congress. After the congress, he crossed the Pacific Ocean to the United States. He stopped at a number of our universities on his homeward journey, beginning with Stanford University and the University of California. He returned home in March, completing the trip around the world.

" Dr. Prandtl visited New York in February and on that occasion was entertained at dinner at the Engineers' Club by a group of forty American engineers. Following the dinner he delivered an address before the Metropolitan Section of the American Society of Mechanical Engineers. Dean George B. Pegram, of Columbia University, presided at the dinner. Dr. Elmer A. Sperry, Past-President of the American Society of Mechanical Engineers and Vice-President of the Daniel Guggenheim Medal Board, introduced Professor Prandtl on the occasion of his address. They had met in Japan.

" Dr. Prandtl was born 4th February, 1875, at Freising, Germany, and attended the technical high school in Munich. He has been Professor at the University of Goettingen since 1904. He has received many honours, among them the Great Gold Medal of the Royal Aeronautical Society of England in 1927 and the Grashof Medal of the Verein Deutscher Ingenieure in 1929. More than any other one man he stands out to-day as distinctly the ' father ' of the present aerodynamic theory. He has written many treatises on subjects related to aviation and is a widely respected authority.

" The members of the Board which made the award are:—*American*: W. D. Durand, E. P. Warner, Elmer A. Sperry, Arthur Nutt, Howard E. Coffin, Paul G. Zimmermann, E. E. Aldrin, Emory S. Land. *Foreign*: Griffith Brewer,

England; Johann Schuette, Germany; Giulio Costanzi, Italy; Baron Chuzaburo Shiba, Japan; Dr. Rateau, of the Societe Francaise de Navigation Aerienne, died before the ballot was cast.

"The first award of the Guggenheim Medal for notable achievement in aeronautics was made to Orville Wright a year ago and the medal was presented to him in Washington on 8th of April in connection with the celebration of the 50th Anniversary of the American Society of Mechanical Engineers. This Society is one of the two American organisations from which members of the Medal Corporation are chosen, the other being the Society of Automotive Engineers. In addition five foreign organisations are represented on the Board of Award, one each in England, France, Germany, Italy and Japan.

"The Medal was founded in 1927 by the Daniel Guggenheim Fund for the Promotion of Aeronautics, of which Mr. Harry F. Guggenheim, now Ambassador to Cuba, was the president. At the annual meeting on 7th May the following officers were elected:—President, William B. Stout, representing the Society of Automotive Engineers, President of the Stout Air Service; Vice-President, Captain E. E. Aldrin, Manager, Aviation Department of the Standard Oil Development Company; Secretary and Treasurer, Alfred D. Flinn, Director of Engineering Foundation; Executive Committee, the President, Captain Aldrin and Mr. E. P. Warner, Editor of 'Aviation'."

Donations

The Council wish gratefully to acknowledge the following gifts:—

A small silver model of Sir Hiram Maxim's Flying Machine, also two lantern slides of the Wright Brothers' Engine of 1903, all from the Science Museum.

Books and papers for the Library from Mrs. Ledeboer and from the Society of British Aircraft Constructors, Limited.

Journal Wanted

No. 11 of the Proceedings of the I.Ae.E.: "Aeroplane Performance Estimates" (Chadwick) is out of stock. Will any member who has a spare copy please communicate with the Secretary?

Membership Badges

For those members of the Society who wish to have them, a badge has been prepared. The badge shows the symbols of the Society, the peregrine and balloon, in finely chased gilt on a blue enamel background, surrounded by a royal blue border on which appears the lettering "Royal Aeronautical Society, 1866." The badges have been hand made with the greatest care so that they will always retain their original appearance, and it is hoped that members will wear them on all suitable occasions. The price is 5/-, or 5/3 post free.

King's Cup Air Race, Hanworth, 5th July, 1930

For the convenience of members, the Secretary has the following tickets for sale at the Society's Offices:—Admission tickets at 5/-, 2/6 and 1/-. Motor car tickets at 2/6.

J. Laurence Pritchard, *Secretary.*

OBITUARY

Henry O'Neil de Hane Segrave

The Council received with deepest regret the news of the death of Major Sir Henry Segrave, who was elected an Associate of the Society in May of this year. Sir Henry was killed on Lake Windermere on 13th June through the capsizing of the motor-boat, Miss England II. The President, Colonel the Master of Sempill, despatched an immediate message of sympathy to Lady Segrave on behalf of the members of the Society, and a floral tribute was sent from the President and Council.

Born on 22nd September, 1896, Sir Henry was educated at Eton and Sandhurst. During the War he served in the 2nd Warwickshire Regiment and then in the Royal Flying Corps. After much service he became disabled as the result of a crash and was posted to the War Office in 1917, and in May, 1918, was appointed Technical Secretary to the Minister for Air. He went to Washington with the British Aviation Mission in the same year.

After the War Sir Henry turned his attention to motor-car racing, and first achieved international fame in 1923 by winning the Grand Prix de France. He won many other important Continental races during the next few years, and achieved several successes at Brooklands. At Daytona Beach, Florida, in 1926, Sir Henry achieved a world record motor-car speed of 203.988 m.p.h., and his last and greatest triumph in road racing was in March, 1929, when he broke the world record at Daytona in the "Golden Arrow" at an average speed of 231.36 m.p.h. He received a great welcome on his return to England, and the honour of Knighthood was conferred upon him for his services to Britain.

Sir Henry then turned his attention to obtaining the water-speed record for Great Britain, in the achievement of which he met his death.

A few months previously, Sir Henry had become technical adviser to an aviation group; and had designed the Segrave "Meteor," a four-seater high-speed low-wing cantilever monoplane.

THE ROYAL AERONAUTICAL SOCIETY

With which is incorporated the Institution of Aeronautical Engineers

MONTHLY NOTICES
AUGUST 1930

Secretary

The Secretary and Editor returned on August 6th from his visit to Canada and the United States of America.

Council Meeting

A meeting of the Council was held on 22nd July, the following being present:—

Colonel the Master of Sempill, A.F.C., A.F.R.Ae.S. (President), in the Chair.

Captain P. D. Acland.	Major G. P. Bulman.
Mr. M. L. Bramson.	Major D. H. Kennedy.
Mr. Griffith Brewer.	Mr. W. O. Manning.
Major J. S. Buchanan.	Mr. L. A. Wingfield.

Staff: Miss Jarvis.

Before the ordinary business of the meeting was dealt with the President and Council had the privilege of welcoming in person two distinguished visitors—Dr. Ames, Chairman of the National Advisory Committee for Aeronautics, Washington, and Professor J. H. Parkin, F.R.Ae.S., Assistant Director of the Division of Physics in the National Research Laboratories, Ottawa.

The President moved a cordial vote of thanks and appreciation to these gentlemen for the way in which they had always co-operated to help the Royal Aeronautical Society. The vote of thanks was seconded by Mr. H. T. Tizard (Rector of the Imperial College of Science and Technology and a former Chairman of the Royal Aeronautical Society), who was also present on this occasion, and carried with acclamation. The visitors then withdrew and the Council proceeded to the business of the meeting. Among the matters dealt with were the following:—

The Report of the Finance Committee, the Report of the Grading Committee, the Report of the Lectures Committee, the Report of the Education and Examinations Committee, the Segrave Memorial Fund, representation on the Advisory Committee on Aeronautical Education of the Imperial College of Science and Technology, representation on the British Gliding Association.

Elections

The following recommendations of the Grading Committee were approved by the Council at their meeting on 22nd July:—

Associate Fellows.—Harold Irvin Birds, Roy Patterson Key, Robert Alexander Seaton (from Associate Member), Oliver Thornycroft.

Students.—Alexander Napier Chinnery-Haldane, George Herbert Ford, William Anthony McGilp, Thomas William Stafford, William George Steven.

Companion.—William McLellan.

British Gliding Association

Colonel the Master of Sempill, the Society's representative on the Council of the British Gliding Association, has been elected a Vice-President of the Association.

Imperial College of Science and Technology

Mr. C. R. Fairey has been re-appointed to represent the Society as a Trade Member on the Advisory Committee on Aeronautical Education of the Imperial College of Science and Technology, South Kensington, for a further period of four years.

Elliott Memorial Prize

The Council have awarded the Elliott Memorial Prize of the Society for the half-year ended June, 1930, to Leading Aircraftsman R. A. C. Carter, who obtained highest marks in the passing-out examinations.

Segrave Memorial Fund

As already announced in the Press, a fund has been started to establish a Trophy in memory of the late Sir Henry Segrave, to be known as the " Segrave Award for Achievement on Land, Water, or in the Air." The Royal Aeronautical Society were invited to appoint a representative for the Committee of the Fund, and the Master of Sempill has been so appointed. Any organisations, members, or others who wish to contribute to the fund should send their donations to the Society's representative.

Donations

The Council wish gratefully to acknowledge the following gifts:—

Journals from Mr. J. Hooley, A.M.I.Ae.E.; Handbooks and Literature from Messrs. Vickers (Aviation), Limited, Weybridge; Photographs of Miss Amy Johnson and Herr Kronfeld from Messrs. Vaughan and Freeman, Limited; a file of " Dammerts Aero-Korrespondenz " and " Deutsche Aero-Korrespondenz," 1924-1927, from Messrs. Trost Brothers.

Journals Wanted

If any members have copies of the Journal for January-April of this year which they do not require, the Secretary would be pleased to hear from them, as these issues are become out of print or scarce.

Membership Badges

For those members of the Society who wish to have them, a badge has been prepared. The badge shows the symbols of the Society, the peregrine and balloon, in finely chased gilt on a blue enamel background, surrounded by a royal blue border on which appears the lettering " Royal Aeronautical Society, 1866." The badges have been hand made with the greatest care so that they will always retain their original appearance, and it is hoped that members will wear them on all suitable occasions. The price is 5/-, or 5/3 post free.

J. Laurence Pritchard, *Secretary.*

OBITUARY

Herbert Guy ffiske

The Council learned with deep regret of the sudden death, on 3rd July, of Major H. G. ffiske, who had been a member of the Society since 1925.

Major ffiske had been connected with Boulton and Paul, of Norwich, since 1907, being manager of their London office. During the War he served in France, first with the Royal Field Artillery and afterwards with the Royal Flying Corps, subsequently in Mesopotamia and Egypt. He retired with the rank of Major and on demobilisation returned to his duties in London. By the death of Major ffiske the Society has lost one of its most esteemed members.

THE
ROYAL AERONAUTICAL SOCIETY
With which is incorporated the Institution of Aeronautical Engineers

MONTHLY NOTICES
SEPTEMBER 1930

Inaugural Lecture

The Inaugural Lecture of the 66th Session will be delivered by the President-Elect, Mr. C. R. Fairey, M.B.E., F.R.Ae.S., on Thursday, October 9th, at 6.30 p.m., in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2. The title of the lecture will be "The Growth of Aviation."

Lecture Programme

The following is a preliminary list of the lectures at present arranged for the first half of the 66th Session:—

Thursday, October 9th.—"The Growth of Aviation," by Mr. C. R. Fairey, M.B.E., F.R.Ae.S.

Thursday, October 23rd.—"Air Transport in Fog," by Mr. F. W. Meredith.

Thursday, November 13th.—"Testing the Control of Aeroplanes," by Mr. H. L. Stevens, A.F.R.Ae.S.

Thursday, November 20th.—"Recent Developments in Engine Cooling, with Special Reference to Oil Cooling," by Captain H. Swan.

Thursday, December 4th.—"The Four-Foot Wind Tunnel," by Mr. H. Glauert, F.R.Ae.S.

Thursday, December 11th.—"Axial Engines," by Mr. M. L. Bramson.

Other lectures are being arranged and particulars will be published as soon as they are available.

Segrave Memorial Fund

As already announced in last month's Journal, a fund has been started to establish a Trophy in memory of the late Sir Henry Segrave, to be known as the "Segrave Award for Achievement on Land, Water, or in the Air."

The Council wish to acknowledge the following contributions to the Fund:—

	£	s.	d.
Messrs. Rolls-Royce, Ltd.	105	0	0
Messrs. Fairey Aviation Company, Ltd.	26	5	0
Messrs. Blackburn Aeroplane Co., Ltd.	25	0	0
Messrs. De Havilland Aircraft Co., Ltd.	10	0	0
Messrs. Westland Aircraft Co. Ltd.	10	0	0

Endowment Fund

A sum of £18 9s. 6d. has been received from Messrs. Gale and Polden to the Endowment Fund. Messrs. Gale and Polden have very generously agreed to pay a certain percentage of their profits arising from the sale of the Aeronautical Diary to the Endowment Fund each year. The Endowment Fund now stands at £1,483 2s. 0d.

The Endowment Fund has been started with the object of obtaining a permanent building as the Society's headquarters and the provision of an income for its upkeep. At present the Society has no lecture hall of its own, nor any lengthy security of tenancy to the building it occupies. The Council wish to draw the attention of all members and those interested in any way in the progress of aeronautics to the Endowment Fund, and to urge them to contribute to the best of their means.

Flight Cadetship at Cranwell

Aircraft Apprentice R. A. C. Carter, a Student Member of the Society, and a winner of the Elliott Memorial Prize, has been selected for a cadetship at the Royal Air Force College, Cranwell, on the result of the examinations held on completion of his three years' training as an aircraft apprentice at No. 1 School of Technical Training (Apprentices), Halton.

Membership Badges

For those members of the Society who wish to have them, a badge has been prepared. The badge shows the symbols of the Society, the peregrine and balloon, in finely chased gilt on a blue enamel background, surrounded by a royal blue border on which appears the lettering "Royal Aeronautical Society, 1866." The badges have been hand made with the greatest care so that they will always retain their original appearance, and it is hoped that members will wear them on all suitable occasions. The price is 5/-, or 5/3 post free.

J. Laurence Pritchard, *Secretary*.

THE
ROYAL AERONAUTICAL SOCIETY
With which is incorporated the Institution of Aeronautical Engineers

MONTHLY NOTICES
OCTOBER 1930

President

Mr. C. R. Fairey, M.B.E., F.R.Ae.S., took over his duties as President of the Society on October 1st.

Inaugural Lecture

The Inaugural Lecture of the 66th Session will be delivered by Mr. C. R. Fairey, M.B.E., F.R.Ae.S., President of the Society, at 6.30 p.m., on Thursday, October 9th, in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2. The subject of the lecture will be "The Growth of Aviation," and will be a technical review of the progress which has been made throughout the world since the end of the war.

The Master of Sempill

Colonel the Master of Sempill, who was succeeded on October 1st as President by Mr. C. R. Fairey, first joined the Society in 1917, and was elected a member of Council in April, 1921, upon which he served continuously until his election as Chairman of the Society in 1926. From October of that year until September 30th, 1930, the Master of Sempill has acted as Chairman (President from 1st January, 1928), being specially re-elected President at meetings of Council held on 8th May, 1928, and 10th May, 1929.

The election of the Master of Sempill to the highest office in the Society was coincident with a great increase in the activities of the Society. The new President devoted all his intense energy to raising the prestige of the Society and increasing its work in all directions. The following figures serve as an eloquent testimony to the Master of Sempill's lively interest in the work he had undertaken. During his period of office there have been fifty Council meetings, of which he presided at all except one. Eighty lectures were delivered before the Society, at seventy-nine of which the President was in the chair. In addition to that there have been innumerable Committee meetings, meetings with other Societies and Institutions, official dinners and lunches, and informal discussions, at which Colonel Sempill has been present on behalf of the Society. These figures alone constitute a record which has rarely been equalled.

It is difficult to estimate the debt the Society owes the Master of Sempill. I have served on the Council with him since he was elected, have served under him as Secretary during all the difficult years he has been Chairman and President. I have, therefore, come into more close contact with him than perhaps any other member of the Society, and have seen his methods of working. During all these years I have called upon him times without number for help and advice which has been given at once and ungrudgingly, often at great personal inconvenience to himself. During his period of office the Society was always first and his own personal activities second. His powers of organisation, his constant kindness and charm, his unfailing consideration for all with whom he came in contact, have proved assets to the Society which can only be

fully realised now that the time has come when, under the Rules of the Society, he must relinquish the reins of office. In any history of the Society the years 1920-1930 will prove to be among the most important since its foundation in 1866. And not a little of the progress which has been made will be found to be due to the Master of Sempill.

The amalgamation with The Institution of Aeronautical Engineers; the organisation of the Society's Exhibit at the Aero Exhibition of 1929; and the increased prestige of the Society are lasting monuments to the work he has done.

J. L. P.

Endowment Fund

The attention of all members and all those who are interested in the scientific and technical progress of aviation is drawn to the Endowment Fund.

The object of this fund is to provide the Society with a suitable building, including a Lecture Hall of its own and a sufficient income for its upkeep. That income should be such that the Society is independent of outside support.

Now that the Guggenheim Fund has come to an end and with it its very generous contribution of £1,000 a year to the funds of the Society, it becomes a vital matter, if the Society is to be enabled to continue its activities on the scale of the past few years, that the Endowment Fund should be increased at a much more rapid rate than it has been in the past.

The fund now stands at £1,483 2s. 0d. It was inaugurated in 1926 and in this connection the following is an extract from a letter received by the President from H.R.H. the Duke of York, a patron of the Society:—

> "The work of the Society is growing constantly in magnitude and importance. Its position can be maintained and improved only if all those connected either directly or indirectly with aeronautics give their fullest support. I hope that those public-spirited persons or bodies who have in the past done so much to help forward other societies will give assistance so that a substantial Endowment Fund may be established."

The powerful position many other scientific and technical societies have reached is very largely due to their Endowment Funds (or their equivalents). Such funds have enabled them to develop and maintain and foster that independence of spirit which is so necessary for scientific progress, which ultimately redounds so much to the standing of the profession concerned. And such is the aim of the Council of the Royal Aeronautical Society.

The future of any society lies in the hands of its members. The growth of the Endowment Fund will ensure that future, will bring an ultimate prestige which comes from the spirit which is independent of fluctuations of income. It is hoped, therefore, that every member will seek every opportunity, in the words of H.R.H., "to give their fullest support . . . so that a substantial Endowment Fund may be established."

Segrave Memorial Fund

In addition to the contributions which were acknowledged in last month's Journal towards a fund to establish a trophy in memory of the late Sir Henry Segrave, to be known as the "Segrave Award for Achievement on Land, Water, or in the Air," the following have been received, and are acknowledged by the Council:—

	£	s.	d.
Mr. Oswald Short	10	10	0
D. Napier and Son, Ltd.	52	10	0
Gloster Aircraft Co., Ltd.	10	0	0
Bristol Aeroplane Co., Ltd.	25	0	0

Photographs

The Council wish gratefully to acknowledge an album of photographs from the Westland Aircraft Works, showing the historical sequence of Westland Aircraft products since the inception of the Aircraft Department of Messrs. Petters, Ltd., in 1915.

This album was sent in response to a request from the Society for photographs of Westland Aircraft to add to the photographic collection which is now being made at the Society's headquarters. Many hundreds of photographs have been received and are now being mounted and indexed with the object of providing an historical collection of photographs of aircraft, heavier and lighter than air, of those who have and are assisting in the development of aircraft, of aircraft engines, parts, and all accessories to aircraft.

It is already evident that many photographs will be required to make the collection really representative, and it is earnestly hoped that all members will help to add to the collection in every way they can, not only by sending photographs which are of historical interest, but photographs of present day interest, so keeping the collection up-to-date.

Acknowledgments

The Council have received and wish to acknowledge a signed photograph of Mr. Orville Wright from Major D. Lester Gardner. This photograph was one of twelve which Mr. Orville Wright specially signed and inscribed, " Kitty Hawk, December 17th, 1928," at Kitty Hawk on the 25th anniversary of the first power-driven flight accomplished by man.

The Council wish gratefully to acknowledge a framed engraving, dated 1802, of M. Garnerin's balloons from Air Vice-Marshal Sir Sefton Brancker. The engraving contains a drawing of M. Garnerin's descent from 8,000 feet in a parachute, " the first ever made in England by a parachute."

The Council wish also to acknowledge the gift from Mr. Bourne of a very interesting paper on Charles Spencer's flying machine, dated 1879, and a letter from John Frederick Bourne, one of the original members of the Society, and a pioneer experimenter with flying models.

The Council have received copies of the January to April, 1930, Journals from Air-Commodore A. D. Warrington-Morris; and nine back issues together with books from Mr. S. Heppolette King, which they wish to acknowledge.

Journal Wanted

Will any member who has a copy of the Journal for November, 1919 (No. 107), please communicate with the Secretary?

Lecture Postponed

The lecture by Mr. M. L. Bramson on " Axial Engines," announced for December 11th in the last issue of the Journal, has unavoidably been postponed.

Correction

The lecture on " Wireless Apparatus for Aircraft," printed in the last number of the Journal, should be by Mr. C. B. Carr, and not C. B. Cave.

Forthcoming Events

Thursday, October 9th.—Lecture, " The Growth of Aviation," by Mr. C. R. Fairey, M.B.E., F.R.Ae.S., President of the Society, in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2, at 6.30 p.m.

Thursday, October 23rd.—Lecture, " Air Transport in Fog," by Mr. F. W. Meredith, in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2, at 6.30 p.m.

J. LAURENCE PRITCHARD, *Secretary.*

OBITUARY

Charles Llewellyn Gerald Colebrook, 1885—1930

The Council record with the deepest regret the death on August 29th of Mr. C. L. G. Colebrook, a Companion of the Society.

The death of C. L. G. Colebrook, who was the aeronautical correspondent of *The Times*, has left a very big gap in the ranks of aeronautical correspondents and one which it will be difficult to fill. Mr. Colebrook was one of the best informed writers on aviation in this country, a man who took the long view, who wrote temperately, and was not led away by the sensations of the moment. He was, indeed, thoroughly sound in his judgments, and a correspondent who was trusted by all with whom he came in contact. Colebrook knew much that he never divulged, and it was this certainty that confidential information would not be made use of which made him the repository of many official secrets.

Mr. Colebrook was born at Brockley, Kent, on July 12th, 1885, and was a reporter on various London papers before the War. He early showed his interest in aircraft, experimenting with model aeroplanes in 1910. In 1915 he enlisted as an air mechanic in the Royal Flying Corps, and in 1916 went to France with No. 22 Squadron. In 1917 he was given a commission as a Technical Officer and served at the Stores Depot at Milton and at the Repair Depot at Farnborough and again in France in 1918. Shortly afterwards he became the aeronautical correspondent for *The Times*, a position he held until his death. British aviation owes much to C. L. G. Colebrook for his steady outlook during the years following the hectic and uneven progress of the war period.

Captain Charles Sutton, 1894—1930

It was with very great regret that the Council learnt of the death of Captain Charles Sutton, an Associate Member, at the early age of thirty-six.

Captain Charles Sutton, who was killed in Lake Ontario, Canada, as a result of a flying accident on September 3rd, was born in London on August 7th, 1894. He joined the R.F.C. in 1916 and was drafted to France in the December of that year as a pilot. In 1917 he was in command of a detached flight for home service against air raiders and in 1918 became an instructor. In 1919 he was in command of a squadron in the Army of Occupation at Cologne, and from 1922-26 saw service in Iraq, Egypt and the Sudan. Leaving the Service he went to Canada, where he has carried out considerable survey and exploration work.

Charles Sutton flew nearly every type of machine from 1916-1926 and had a record of some 2,000 hours flying. The air was his hobby and by his death the Society loses one of its most enthusiastic flying members.

THE
ROYAL AERONAUTICAL SOCIETY

With which is incorporated the Institution of Aeronautical Engineers

MONTHLY NOTICES
NOVEMBER 1930

R 101 Disaster

Many messages have been received from all over the world by the Society, both from its own members and from private individuals as well as foreign institutions, expressing the deepest sympathy with the relatives of those who lost their lives and with the Society at the loss of some of its most brilliant members in the R.101 disaster. A wreath was sent to Cardington on behalf of the Council and all members of the Society.

Among the letters and telegrams of sympathy received were those from Colonel N. Belaiew; J. Benson, Esq.; Count Bernstorff; William G. Cox, Esq.; Dr. Hugo Eckener; Major Lester D. Gardner; Professor W. Georgii; Professor R. Giacomelli; Harry F. Guggenheim; Mr. Halle, of the Royal Norwegian Aero Club; Doctor Kiep; R. Langer, Esq.; R. M. Morrison, Esq.; W. Stern, Esq.; Herman Volk, Esq.; Edward Warner, Esq.; the Wissenschaftliche Gesellschaft fur Luftfahrt; Associazione Italiana Aerotecnica; the 1er. Congrès International de la Sécurité Aérienne; the Institution of Automobile Engineers; Institut der Rhon-Rossitten-Gesellschaft, Wasserkuppe.

The President and Council wish once more to thank all those who have sent messages of sympathy on the occasion of the greatest disaster to British aviation.

R 101 Inquiry

The Court of Inquiry into the R.101 disaster consists of Sir John Simon, Lieut.-Colonel J. T. C. Moore-Brabazon and Professor C. E. Inglis have been appointed Assessors. Lieut.-Colonel Moore-Brabazon is a Vice-President of the Society.

Council Meeting

A Meeting of Council was held in the offices of the Society on Tuesday, 30th September.

Present:—Colonel the Master of Sempill in the chair, Captain P. D. Acland, Major T. M. Barlow, Mr. M. L. Bramson, Sir Sefton Brancker, Mr. Griffith Brewer, Major J. S. Buchanan, Major G. P. Bulman, Mr. C. R. Fairey, Captain F. T. Hill, Mr. J. E. Hodgson (Hon. Librarian), Major D. H. Kennedy (Hon. Treasurer), Captain A. G. Lamplugh, Mr. W. O. Manning, Major R. H. Mayo, Lieut.-Col. J. T. C. Moore-Brabazon, Mr. C. C. Walker, Mr. H. E. Wimperis, Air Vice-Marshal Sir Vyell Vyvyan, Mr. L. A. Wingfield.

Among the business transacted was the following:—The Segrave Memorial Fund; the Endowment Fund; the report of the Grading Committee; the report of the Finance Committee; the lecture programme; appointment of referees for the Akroyd Stuart Prize; papers to the 1st International Safety Aircraft Congress in Paris.

Endowment Fund

The progress of any industry depends, ultimately, upon the progress made in that industry by its research workers. This applies more perhaps to aviation than to any other industry. The real advance in flying technique, in construction, in aerodynamic efficiency, in engine design, lies with the research worker. Money spent on research is returned a hundredfold in aviation and every big advance which has been made in aircraft in the last twenty years has been the result of painstaking experiment, observation and research.

The fundamental object of the existence of the Royal Aeronautical Society is to promote the general advancement of aeronautical science and engineering. To carry out its object in the best possible way it must have the proper organisation and facilities, it must have that prestige which attracts to it all the best in the world of aeronautical science. It has the prestige, and it numbers among its members all those who are treading the path of scientific progress in aviation. But it most certainly has not the proper facilities for carrying out, in an adequate way, the fundamental object for which it exists.

The Council have inaugurated the Endowment Fund with the sole object of providing these facilities. They are a suitable building, including a lecture hall of its own, and a sufficient income for its upkeep and for making the Society independent of outside support.

The powerful position many other scientific and technical societies has reached is largely due to their Endowment Funds (or their equivalents). Such funds have enabled them to develop and maintain and foster that independence of spirit which ultimately redounds so much to the status of the profession concerned.

The future of any society lies in the hands of its members. The future of the Royal Aeronautical Society lies in the hands of *its* members. The growth of the Endowment Fund will ensure that future.

It is hoped that every member will contribute towards that fund as lies within his means. The fund now stands at £1,483 2s. 0d. To place the Society on a firm basis it should stand at £20,000 at least.

Elections

At a Meeting of Council on Tuesday, September 30th, the following recommendations of the Grading Committee were approved:—

Associate Fellows.—Albert Oliver Adams (from Associate Member), Debrabrata Chakraverti, Air Commodore Hugh Caswall Tremenheere Dowding, Vivian Valentine Max Ernst, Lieut. Carlos Manuel Gadda (from Associate), Air Vice-Marshal Frederick Crosby Halahan, Flight Lieut. James Alexander Gordon Haslam, James Oswald Mortlock (from Student), Captain Andrew Swan, Arthur Edgar Woodward-Nutt (from Student).

Associate Member.—Raymond Vaughan Fowler.

Associates.—Stanley James Gilbert, Charles William Hewitt, Harry Percy Thomas.

Students.—John Searle Drewett, Herbert George Edmonds, Baidya Nath Ghosh, Richard Charles London, George Wilfrid Mullett, Noel Henry Nash, John Alfred Sheppard, Kenneth F. Tupper, John Colin Turnbull, Richard Babington Winn.

Membership Badges

For those members of the Society who wish to have them, a badge has been prepared. The badge shows the symbols of the Society, the peregrine and balloon, in finely chased gilt on a blue enamel background, surrounded by a

royal blue border on which appears the lettering " Royal Aeronautical Society, 1866." The badges have been hand made with the greatest care so that they will always retain their original appearance, and it is hoped that members will wear them on all suitable occasions. The price is 5/-, or 5/3 post free.

Forthcoming Events

Thursday, November 13th.—Lecture by Mr. H. L. Stevens on " Testing Aeroplane Controls," in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2, at 6.30 p.m.

Thursday, November 13th.—Lecture before the Yeovil Branch on " Triplex Glass Making."

Thursday, November 20th.—Lecture by Captain H. Swan on " Recent Developments in Engine Cooling, with a reference to Oil Cooling," in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2, at **7.30 p.m.** Joint lecture with the Institution of Automobile Engineers. Members should please note change of time for this lecture.

Thursday, November 20th.—Lecture before the Yeovil Branch on " Aircraft Detail Design—The Shops' Viewpoint," by W. G. Gibson.

Friday, November 28th.—Lecture before the Yeovil Branch on " The Westland Wapiti in India," by Group Capt. R. H. Verney, O.B.E.

Friday, November 28th.—Lecture before the Hull and Leeds Branch on " The Importance of the Boundary Layer," by H. Glauert, M.A., F.R.Ae.S.

J. LAURENCE PRITCHARD, *Secretary.*

THE

ROYAL AERONAUTICAL SOCIETY

With which is incorporated the Institution of Aeronautical Engineers

MONTHLY NOTICES

DECEMBER 1930

Journal

This month's Journal contains a summary of the Society's activities during the past year. This summary will be supplemented by the annual report of Council which will appear as usual in the March issue. A number of the usual notices, *e.g.*, Elections, appear in the summary and are not reprinted in this monthly notice.

Council

A meeting of Council was held on Tuesday, October 28th, in the offices of the Society.

Present: Mr. C. R. Fairey, in the Chair, Captain P. D. Acland, Major T. M. Barlow, Mr. M. L. Bramson, Mr. Griffith Brewer, Major G. P. Bulman, Wing-Commander T. R. Cave-Browne-Cave, Captain F. T. Hill, Mr. W. O. Manning, Major R. H. Mayo, Lieut.-Colonel J. T. C. Moore-Brabazon, Colonel the Master of Sempill, Mr. C. C. Walker, Mr. H. E. Wimperis, Mr. L. A. Wingfield.

Among the business transacted was the following:—The Endowment Fund Appeal; the Report of the Grading Committee; the Report of the Finance Committee; and the R.101 disaster.

A meeting of Council was held on Tuesday, November 18th, in the offices of the Society.

Present: Mr. C. R. Fairey, in the Chair, Captain P. D. Acland, Major T. M. Barlow, Mr. M. L. Bramson, Mr. Griffith Brewer, Major J. S. Buchanan, Major G. P. Bulman, Wing-Commander T. R. Cave-Browne-Cave, Captain F. T. Hill, Major D. H. Kennedy, Captain A. G. Lamplugh, Mr. W. O. Manning, Major R. H. Mayo, Colonel the Master of Sempill, Mr. C. C. Walker, Mr. L. A. Wingfield.

Among the business transacted was the following:—The Endowment Fund Appeal; the R.101 disaster; the Report of the Secretary's visit to Canada; the Report of the Grading Committee; the Report of the Finance Committee; appointment of delegates to the 1st International Air Safety Congress in Paris; application from Gloucester and Cheltenham for the formation of a new branch; the Report of the Referees on the Akroyd Stuart Memorial Prize papers; and the Lecture Programme for the Second Half of the Session.

Air Vice-Marshal Sir W. S. Brancker

At the Council meeting held on October 28th, the following resolution was passed:—

"The Council wish to place on record their sense of the heavy loss which the Society sustained by the deaths of many of its members in the disaster to R.101. And particularly they wish to record their deep regret at the death of their Past-President, Air Vice-Marshal Sir William Sefton Brancker, K.C.B., A.F.C., who rendered such great services to the Society during his years of office on the Council."

Colonel The Master of Sempill

Following the Council meeting of November 18th, past and present members of Council gave a dinner to Colonel the Master of Sempill, Past-President, and presented him with a case of cutlery suitably engraved. A list of those who attended and many of the messages read on that occasion appears in the summary of the Society's activities in this issue.

Akroyd Stuart Memorial Prize

The Council received the report of the referees appointed to consider the papers submitted for the Akroyd Stuart Memorial Prize and Lecture. As a result of this report the Council have awarded the Prize for 1928-30 to Mr. D. R. Pye, M.A., F.R.Ae.S., for his paper on "The Origin and Development of Heavy Oil Engines." Mr. Pye will read his paper on Thursday, December 11th, in the Lecture Hall of the Royal Society of Arts.

Lecture Programme, 1931

The following lectures have been provisionally arranged for the Second Half of the 66th Session:—

January 8th, 1931.—"Some Aspects of the Design and Construction of Sea-going Aircraft," Mr. A. Gouge, B.Sc., A.F.R.Ae.S.

January 22nd.—"Deck Flying," Squadron-Leader W. R. D. Acland, D.F.C., A.F.C.

January 29th.—"Development and Construction of Sailplanes and Gliders," Herr Lippisch.

February 12th.—"Air Navigation," Captain N. Macmillan, M.C., A.F.C., A.F.R.Ae.S. (Joint meeting with the Guild of Air Pilots and Air Navigators).

February 26th.—"Meteorological Aspects of Gliding and Soaring," Capt. F. Entwistle, B.Sc. (Joint meeting with the British Gliding Association).

March 19th.—"Research in the Berlin Technische Hochschule," Dr. W. Hoff.

April 16th.—"Noise," Dr. A. H. Davis.

April 30th.—"Aerodynamics of Sails," Dr. Manfred Curry.

May 14th.—"The Metal Clad Airship," Mr. Carl B. Fritsche.

All lectures will be held in the Royal Society of Arts, 18, John Street, Adelphi, W.C.2, at 6.30 p.m.

Forthcoming Events

Tuesday, December 2nd.—Lecture before the Students' Section, "Commercial Uses of a Four-Foot Wind Channel," S. D. Davies, in the Library of the Society at 6.30 p.m.

Thursday, December 4th.—Lecture before the Society in the Royal Society of Arts, 18, John Street, Adelphi, W.C.2, at 6.30 p.m., by Mr. H. Glauert, M.A., F.R.Ae.S., on "The Use of Small Wind Tunnels in Aeroplane Design."

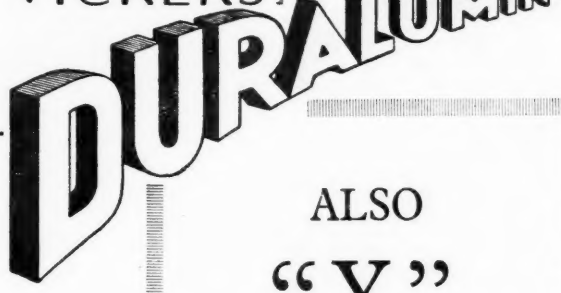
Tuesday, December 9th.—Lecture before the Manchester Branch, "The Development of Air-Cooled Engines," by J. C. Briggs.

Thursday, December 11th.—The Akroyd Stuart Memorial Prize Lecture before the Society in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2, at 6.30 p.m., by Mr. D. R. Pye, M.A., F.R.Ae.S., on "The Origin and Development of Heavy Oil Engines."

Friday, December 12th.—Lecture before the Yeovil Branch, "Float and Boat Seaplanes," by Mr. Jackson, of Messrs. Short Bros.

J. LAURENCE PRITCHARD, *Secretary*.

VICKERS'



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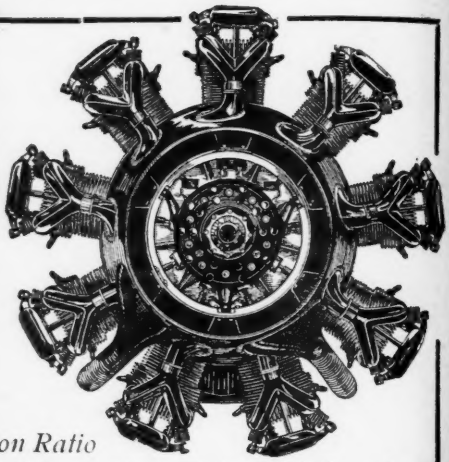

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